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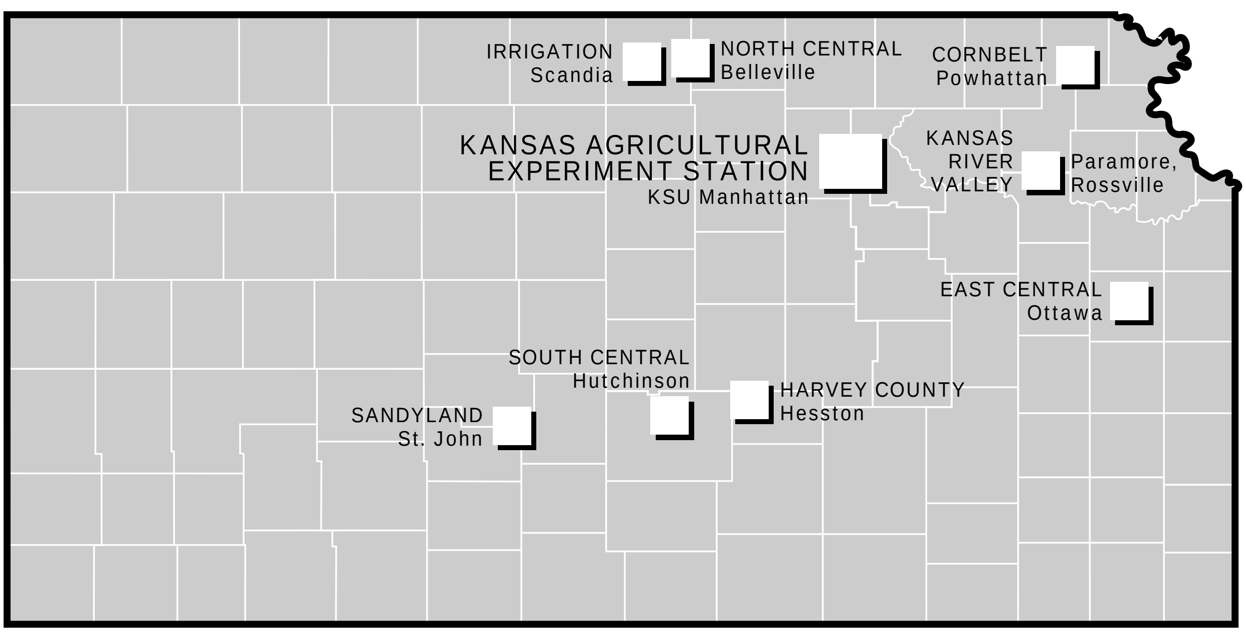

Agronomy and Biological & Agricultural Engineering Experiment Fields

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CORNBELT EXPERIMENT FIELD

Introduction

The Cornbelt Field was established in 1954 through the efforts of local interest groups, Kansas State University, and the state legislature. The objective then was to conduct research on the propagation, culture, and development of small-seeded legumes.

Emphasis since 1960 has been on fertilizer materials (rates, placement, and times of application); row spacings, planting rates, and dates; variety testing; control of weeds and insects; cultural practices, including disease- and insect-resistant varieties; and cropping systems. Foundation seed of oat, wheat, and soybean cultivars is produced to provide a source of quality seed of public varieties.

Soil Description

The soils on the Experiment Field are silty, windblown, Pleistocene sediments called loess (pronounced luss). Grundy silty clay loam, the dominant soil, has a black silty clay loam surface, usually more than 15 inches thick, and a silty clay subsoil. It typically occupies ridge crests and tablelands of western and southeastern Brown County and is extensive in northeastern Jackson, western Atchison, eastern Jefferson, and western Leavenworth counties in Kansas, as well as in western Richardson County, Nebraska. Grundy soil is similar to the Wymore soil of Nemaha and Marshall counties, Kansas and of Pawnee County, Nebraska.

The nearly level slopes have thick surface soil, which thins rapidly as slopes increase. Gradient terraces usually are needed to reduce sheet erosion, which is a serious hazard because the subsoil absorbs water slowly.

Weather

Rainfall during the majority of the growing season in 1997 was below normal and widely variable. Stored soil moisture was essential to maintain vegetative growth. This resulted in good yields in some parts of the field and below-average yields in other parts.

The last killing frost was on April 17 (normal April 25), and the first killing frost was on October 26 (normal October 15). The frost-free period was 19 days longer than the 173-day average.

Table 1. Precipitation at Cornbelt Experiment Field, inches.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
						1997						
0.17	2.20	0.21	5.40	3.33	2.10	4.02	3.43	1.75	3.68	1.73	1.81	29.83
						41-Year Average						
0.78	0.75	2.30	3.01	4.82	5.00	4.53	4.07	4.49	2.79	1.84	1.04	35.42

STARTER PHOSPHORUS FERTILIZER - CORN HYBRID - SOIL PH INTERACTIONS FOR NORTHEAST KANSAS

Brian H. Marsh

Summary

Nitrogen (N) and phosphorus (P) starter fertilizers were 2 by 2 banded at planting. Although differences in response among five corn hybrids were observed, starter fertilizer significantly increased grain yield on a 2-year average for all hybrids. Root growth and P uptake was greater in the fertilizer band, especially early in the growing season. Added P fertilizer did increase yield at very low pH without a soil pH change.

Introduction

Extensive research has been conducted to determine generalized relationships among soil P fertility levels, added P fertilizer rates and placement, plant nutrient uptake, growth, and grain yield. This has been done over many years and has included many soil types, hybrids, climatic environments, and cropping systems. Recent research in site-specific management and precision agriculture has prompted a reassessment of this aggregate information. Not all sites and cropping systems fit the generalized recommendations. Various starter and P fertilizer studies conducted at the Cornbelt Experiment Field over the past 30 years have shown little yield response to added P fertilizer. Soil P tests were in the medium range (20-30 lbs/a), and yields were less than 130 bu/a. These studies also have shown that hybrids can dramatically affect the results. Site-specific research was conducted at the Cornbelt Experiment Field during 1996 and 1997 to look at effects of the interactions of starter P, corn hybrid, and soil pH on root and shoot growth, nutrient uptake, and yield of corn.

Procedures

Starter fertilizer studies were conducted at Cornbelt Experiment Field on a Grundy silty clay loam soil. In 1996, the field used had a soil P test of 24 lbs/a and a soil pH of 6.1 in the surface 6 inches. In 1997, the test was conducted in a field that had been limed previously at various rates. Average soil P was 20 lbs/a, and soil pH levels were 5.1, 6.0, 7.1, and 7.6. Only data from the soil pH 6.0 plots was combined with the 1996 data. All other agronomic inputs were the same each year. Starter fertilizer (30-30) was applied in a band 2 inches to the side and 2 inches below the seed at planting. The N fertilizer source was urea ammonium nitrate (28% UAN) and P fertilizer was ammonium polyphosphate (10-34-0). Nitrogen fertilizer was balanced with surface application at 120 lbs/a. Corn hybrids were planted in 30-inch rows at 22,000 seeds/a on May 21, 1996 and May 6, 1997. Hybrids selected were DeKalb 636, Pioneer 3563, Pioneer 3346, ICI 8599, and DeKalb 591. These hybrids represent a range in maturity.

Plant and root samples were collected at approximately growth stage V6 on June 28, 1996 and June 23, 1997. Plant and root samples were collected in 1996 at 2-week intervals following planting. Root samples were grid subdivided to evaluate rooting patterns. Roots were removed from the soil by hydropneumatic elutriation. Root length and area were measured using a digitized image. Ear leaf samples were collected each year at silking. Stover samples were collected at maturity. Grain was harvested with a small plot combine on October 13, 1996 and October 2, 1997.

Results

Agronomic responses to starter fertilizer in 1996 and 1997 were very dramatic. Previous research conducted at the Cornbelt Experiment Field in the 1960's and from 1987-92 had shown little response to starter P fertilizer. Yields in all of those studies had been less than 130 bu/a. Hybrid selection or rainfall had been the limiting factors, not P deficiency. Other research has shown that a 1:1 ratio of N:P in the starter fertilizer has had the most positive results. The synergistic effect of having both essential nutrients in the same fertilizer band increases root growth, nutrient uptake, plant growth, and yield over those resulting from each nutrient banded alone.

In 1996, grain yields averaged over all hybrids were higher with the addition of starter P fertilizer. Pioneer 3346 had the smallest increase of 10 bu/a. In 1997, all hybrids had significant yield increases with the starter fertilizer addition. The same occurred for the 2-year average. Ear leaf N and P were significantly higher averaged over all hybrids. ICI 8599 had lower N and P ear leaf concentrations. However, this hybrid had the greatest increase in dry matter accumulation and uptakes of N and P (data not shown). The lower ear leaf concentration shows a dilution effect. This hybrid also had the largest 2-year average increase in grain yield. The ear leaf P concentration for the P- fertilized treatments was just above the published critical level. Phosphorus concentration from the untreated plots suggests a “hidden hunger” level. Visual symptoms of P deficiency were not observed, but the low concentrations did have a negative effect on grain yield.

The banding of N and P together had a positive effect on root growth. Banding fertilizer created an area of higher P concentration in the soil (Figure 1). The band was located where the radical or the lateral seminal roots would intersect it in their natural downward growth. These are the first roots to grow from the germinating seed and are critical to the early nutrition of the plant. This effect is more pronounced early in the growing season. Root growth at 2 weeks after planting was 3 times greater in the area where starter fertilizer was banded than the unfertilized treatment (Figure 3). At 6 weeks after planting, root growth was 2½ times greater, and at 10 weeks after planting only, 1¼ times greater. Total root growth was greater for the starter fertilizer treatment but the difference was not as dramatic as what was measured in the band area. The starter fertilizer improved early-season root growth, which lead to more N and P uptakes and higher dry matter accumulation. The better early-season vigor resulted in improved yields. Improved nutrition in the plant also promoted additional root growth deeper in the soil profile (Figure 2). Water is extracted slowly from the heavy clay subsoil. The small increase in root growth was very critical for additional water uptake.

Conclusions

Soil tests provide important information about the nutrient status of the soil and the potential for plant response to added fertilizer. Although individual fields and selected hybrids do respond differently, starter fertilizer addition, based on a soil test and appropriate interpretation, improves early- season shoot and root growth, nutrient uptake, and grain yield. The added P is not lost when weather conditions limit grain yield and will be available for other crops. Stratification of nutrients in the soil from banding fertilizer also must be considered when soil sampling. More samples should be collected for compositing to ensure a representative soil for analysis and interpretation.

Table 2. Effects of starter fertilizer on yield and ear leaf nutrient concentrations of corn. Cornbelt Experiment Field.

		Yield			1996 Ear Leaf	
Hybrid	Starter	1996	1997	2-Year Avg.	N	P
			bu/a		%	
DK 636	Without	137	100	118	2.00	0.219
	With	151	133	142	2.18	0.229
P 3563	Without	153	120	137	2.17	0.258
	With	167	167	167	2.36	0.294
P 3346	Without	153	122	138	2.07	0.219
	With	163	158	161	2.25	0.249
ICI 8599	Without	132	105	119	2.14	0.220
	With	173	135	154	1.96	0.211
DK 591	Without	123	129	126	2.18	0.246
	With	166	146	156	2.48	0.284
$LSD_{0.05}$		16	17	12	0.23	0.013
$LSD_{0.10}$		13	14	10	0.19	0.011
Avg. of all hybrids	Without	140	115	128	2.11	0.232
	With	164	148	156	2.24	0.253

Table 3. Effects of soil pH and starter fertilizer application on yield and ear leaf P of corn. Cornbelt Experiment Field.

Soil pH	Starter	Yield	Ear Leaf P	Soil pH	Starter	Yield	Ear Leaf P
		bu/a	ppm			bu/a	ppm
	Without	121	0.267	5.1	Without	109	0.235
	With	141	0.284		With	143	0.265
				6.0	Without	122	0.271
					With	149	0.278
5.1		126	0.250	7.1	Without	124	0.276
6.0		137	0.275		With	141	0.293
7.1		132	0.284	7.6	Without	130	0.287
7.6		139	0.294		With	148	0.302
$LSD_{0.05}$		5	0.013	$LSD_{0.05}$		7	0.019

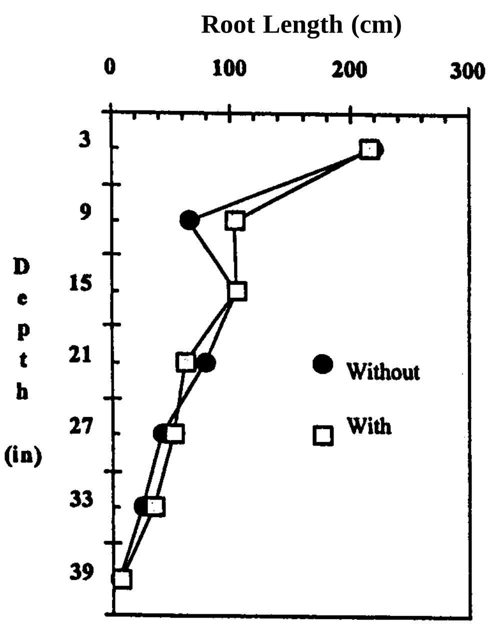


Figure 1. Soil phosphorus profile.

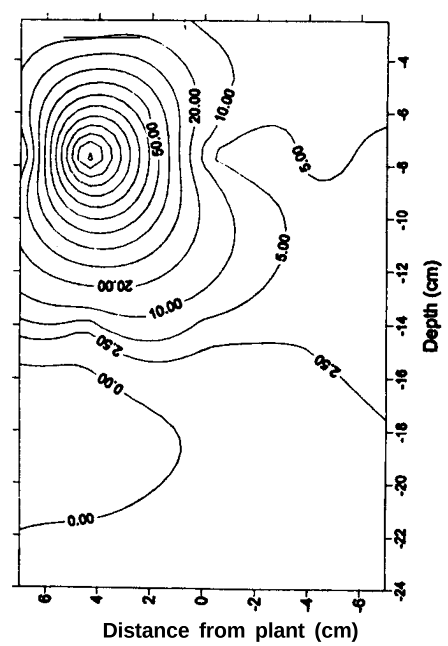


Figure 2. Corn root growth by depth.

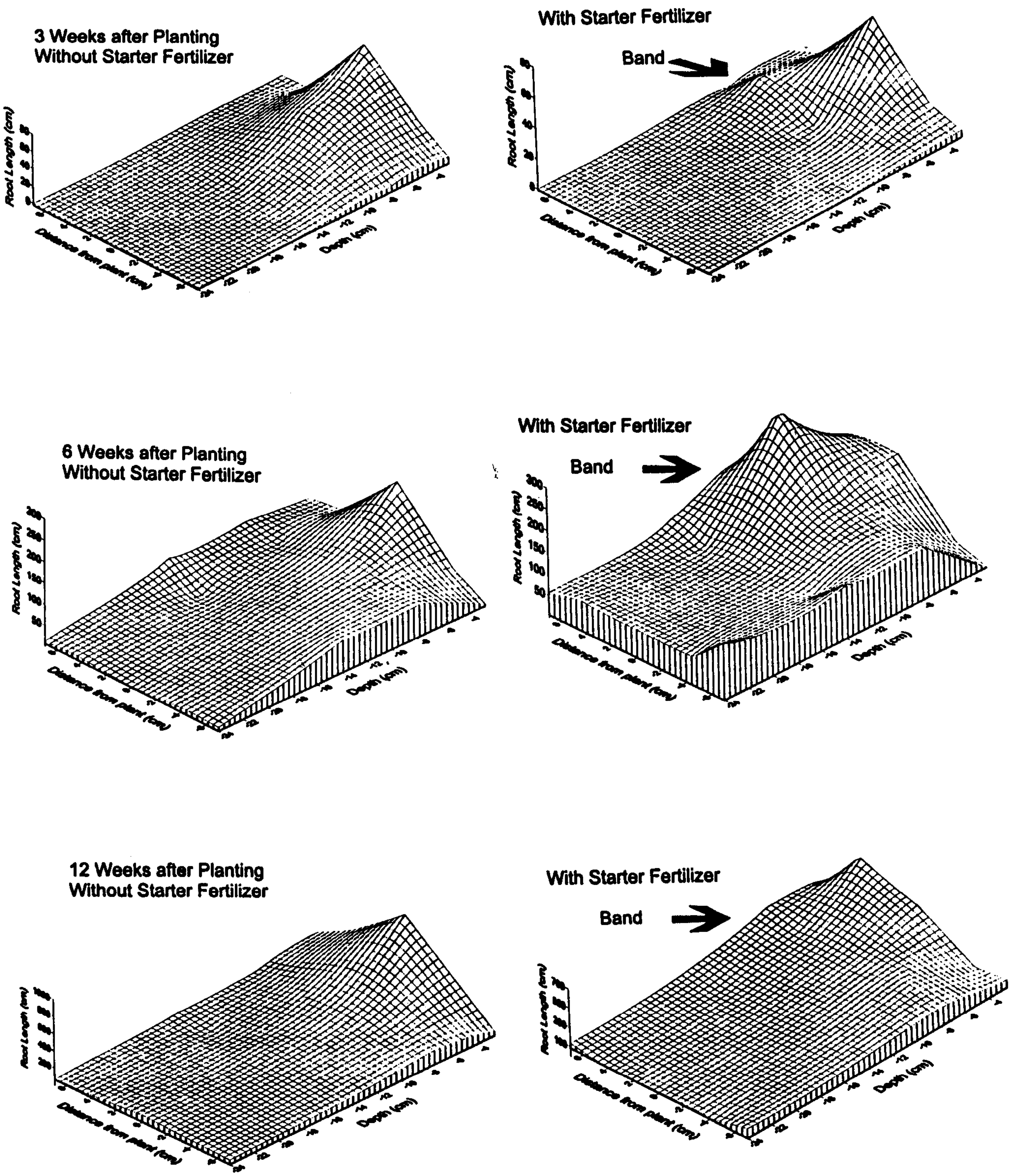


Figure 3. Corn root growth at 3, 6, and 12 weeks after planting.

EFFECTS OF UNIFORM ANHYDROUS AMMONIA APPLICATION ON CORN GROWTH

Brian H. Marsh

Summary

Anhydrous ammonia is a widely used source of fertilizer nitrogen (N). However, its physical properties can create some problems for uniform field application with certain types of metering and distribution systems. Grain yields are higher when applications of anhydrous ammonia are more uniform, because small areas of lower yields from inadequate N application are minimized.

Introduction

Pulse width modulation has been shown to be a very accurate method to control the rate of liquid flow while maintaining a constant pressure. Flow is controlled by the valve size and the duration that the valve remains open, cycling at 10 hertz. For agriculture spray applications, droplet size can be constant across a wide range of application rates. Pulse width modulation valves were tested for use with anhydrous ammonia. A field application study also was performed to evaluate effects of uniform and nonuniform anhydrous ammonia applications on corn growth and yield.

Procedures

A static test was performed with two anhydrous ammonia controllers at several combinations of application rate, tank pressure, air temperature, and back pressure. At least three replications were used with each combination. One controller utilized a variable diameter orifice (VDO) to control flow with a multiple outlet manifold for distribution. This is a typical controller used on many applicators. Pulse width modulation (PWM) uses a standard electronic sprayer control and flow meter to measure and control total application but has individual valves for each shank.

Anhydrous ammonia output was measured from each of the seven outlets. Each outlet was immersed in water of uniform depth in 50 gallon plastic trash cans. Water is used to safely absorb the anhydrous ammonia because of the quick reaction between the two. Can weights were measured before and after each run.

The field study included two sets of plots. The first was a two by three complete factorial design with four replications. Two controllers and three N rates were the factors used. VOD and PWM were the controller types used with N rates of 0, 60, and 120 lbs N/a. Plots were eight 30-in.-rows wide by 50 ft. long. The previous crop was soybean. Herbicides were applied and incorporated on April 28. Pioneer hybrid 3335 was planted on April 29. Anhydrous ammonia was applied on June 11 at growth stage V8. Ear leaf samples were collected at tasseling. Grain was harvested with a small plot combine on October 6.

The other plot contained a single set of treatments eight rows wide and 400 ft. long. The same cultural practices were used. Plants were thinned for a uniform stand. Soil samples were collected on June 19. A single 2⅛ inch core was taken from the 3- to 7-inch depth in each fertilizer shank area between the corn rows. Four samples were collected from each row 30 ft. apart and analyzed for ammonium and nitrate N. Three plants from each row adjacent to where the soil sample was taken were collected at maturity. Ears were hand harvested, and grain yield was measured and converted to a per acre basis. Stover and grain were weighed and ground for chemical analysis.

Results

Testing of the anhydrous ammonia application rate and distribution with the VDO meter and semicircular manifold produced unsatisfactory results. Total application (160 lbs) was less than the meter setting (200 lbs). Distribution among the outlets was also quite variable. The data shown in Figure 4 were for one of the test combinations. Other combinations produced similar results. Output from the PWM meter had significantly better results. Total output was within 4% of target output, and distribution among the shanks was not significantly different. The test valves performed satisfactorily.

Soil samples from the unfertilized field plots had N concentrations from 7 to 14 ppm and averaged 10 ppm (Table 4). The coefficient of variation was 23%. Grain yield for the corresponding samples ranged from 86 to 158 bu/a, averaging 123 bu/a with a coefficient of variation of 15% (Table 5). Soil N from the VDO application of 120 lbs N/a ranged from 22 ppm to 216 ppm with an average of 105 ppm. The coefficient of variation was 52%. The uniformity of anhydrous ammonia application with the VDO meter and semicircular manifold was very poor. Samples taken 30 in. apart differed by as much as 138 ppm. Samples taken down the row also showed a wide range of variability. Yield estimates from the small row sections ranged from 102 to 186 bu/a with a coefficient of variation of 18%. Many factors contribute to grain yield. Moisture is most often the limiting factor, but in this case, the nonuniformity of anhydrous ammonia application increased the variability in yield as spot measured throughout the field.

A more uniform application of anhydrous ammonia was achieved with the PWM metering system. Soil N ranged from 61 ppm to 140 ppm with an average of 107 ppm and a coefficient of variation of 17%. Grain yields were less variable, ranging from 120 to 188 bu/a with a coefficient of variation of 13%. The more uniform anhydrous ammonia application eliminated the extremes of over- and underapplication associated with the VDO metering system.

Grain yields measured in the replicated plots showed an significant increase as N rate increased (Table 6). The zero N and 60 lbs N/a treatments from both metering systems were yield limited by the under-application of N. A significant difference in yield was observed for the highest N rate between the two metering systems. The VDO system had areas where N was overapplied and did not contribute to grain yield. Areas of underapplication also were observed. These areas also were yield limited because of the lack of N. Because the PWM metering system did not have areas of extreme over- and underapplication, small areas of low yields were not observed. The result was an overall higher yield as measured in the replicated plots.

Conclusions

Ammonia N is converted to nitrate N in the soil and is fairly mobile, but that does not mean that it will be distributed uniformly in the soil and result in equivalent plant uptake. Grain yields were more variable when distribution of applied N was highly variable. A reduction the number of small low-yielding areas increased overall yield. Corn grain yields were higher when anhydrous ammonia was applied uniformly. Some types of metering and distribution systems for anhydrous ammonia apply it in a nonuniform manner that negatively affects corn yield.

Table 4. Soil N (ppm) from grid soil sampling between corn rows. Cornbelt Experiment Field, 1997.

Zero Nitrogen						
14	12	13	14	12	10	12
12	14	11	10	10	10	11
12	8	9	7	7	7	11
9	11	7	7	8	14	8
Variable Diameter Orifice, 120 lbs N/a						
79	22	51	126	177	79	34
41	127	96	93	117	42	82
106	148	41	179	216	198	106
71	22	111	119	130	30	63
Pulse Width Modulation, 120 lbs N/a						
91	101	134	121	100	85	130
80	100	123	95	111	95	92
61	103	126	112	140	124	107
93	99	102	123	109	112	127

Table 5. Estimated corn grain yield (bu/a) for each row from small row subsamples. Cornbelt Experiment Field, 1997.

Zero Nitrogen							
126	86	110	149	132	132	124	135
128	117	127	105	158	118	132	102
126	108	131	110	126	94	107	107
139	96	147	156	108	124	149	149
Variable Diameter Orifice, 120 lbs N/a							
147	134	167	129	150	147	169	164
167	161	158	166	186	174	153	147
104	123	94	180	180	156	102	102
192	110	147	140	156	153	162	162
Pulse Width Modulation, 120 lbs N/a							
150	151	132	120	148	151	171	164
150	110	161	183	134	147	128	159
171	177	150	188	151	188	183	153
163	150	140	159	140	145	155	173

Table 6. Effects of controller and N rates interaction on ear leaf N and grain yield of corn. Cornbelt Experiment Field.

Controller	Rate	Ear Leaf N	Grain Yield
	lbs N/a	%	bu/a
	0	1.57	113
VDO	60	1.92	126
PWM	60	2.20	128
VDO	120	1.86	144
PWM	120	2.24	153
$LSD_{0.05}$		0.26	8

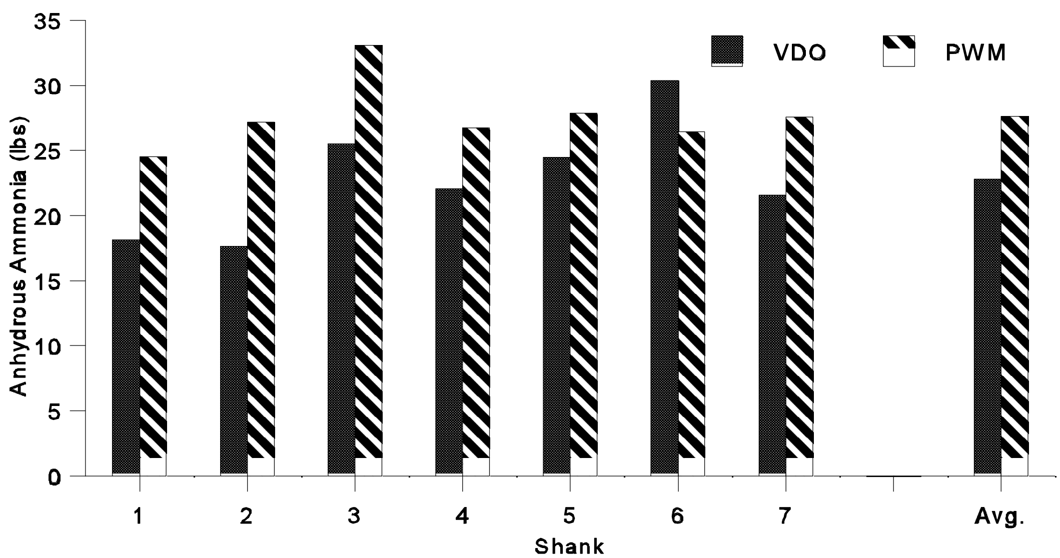


Figure 4. Controller effect on anhydrous ammonia output. Cornbelt Experiment Field, 1997.

EVALUATION OF CORN HERBICIDES

Brian H. Marsh

Summary

Selected broadleaf and grass herbicides for corn were evaluated for weed control and phytotoxicity. Low rainfall during the summer limited grain yield. Grass weed control was less than 80% and had a negative effect on grain yield.

Procedures

One hundred pounds of nitrogen (N) were applied as anhydrous ammonia on April 2. All preplant incorporated (PPI) and preemergence (PRE) treatments were applied on April 29. A field cultivator was used on the PPI applications. All treatments were applied in 15 gal./a of water. Corn hybrid Garst 8396IT was planted at 22,600 seeds/a in 30 in. rows on May 6. Postemergence (POST) treatments were applied on June 13, 1997. Weed control and phytotoxicity were rated on June 23 and July 14. Grass weeds rated were giant foxtail and large crabgrass. Broadleaves included velvetleaf and redroot pigweed. Plots were harvested with a small plot combine on October 10.

Results

Low rainfall from May through September limited grain yields and had an adverse effect on chemical weed control. Adequate grass weed control was obtained for all preplant applications of Dual (Table 6). Poor grass control early in the growing season had a negative effect on yield. Broadleaf weed control was good with all treatments. No phytotoxicity was observed for any treatments.

Funded in part by Dow AgroSciences

Table 7. Effects of corn herbicides on grain yield and weed control. Cornbelt Experiment Field, 1997.

				Grasses		Broadleaves	
Treatment	Rate	Timing	Yield	6/23	7/14	6/23	7/14
	/a		bu/a	% control			
Broadstrike SF + Dual	2 lb	PPI	92	80	88	92	93
Aatrex	1 lb						
Broadstrike SF + Dual	2 lb	PRE	108	93	92	90	95
Aatrex	1 lb						
Hornet	0.21 lb	PRE	71	70	78	85	93
Topnotch	2 qt						
Hornet	0.21 lb	PRE	81	70	80	90	93
Surpass 100	2 qt						

(continued)

Table 7. Effects of corn herbicides on grain yield and weed control. Cornbelt Experiment Field, 1997.

Treatment	Rate	Timing	Yield	Grasses 6/23	Grasses 7/14	Broadleaves 6/23	Broadleaves 7/14
	/a		bu/a	% control			
Hornet	2.4 oz	POST	69	57	70	90	95
Basis Gold	14 oz						
Dual II	2 lb	PRE	116	95	96	93	92
Hornet	1.6 oz	POST					
Aatrex	1 lb						
Dual II	2 lb	PRE	98	90	87	83	95
Hornet	2.4 oz	POST					
Aatrex	1 lb						
Dual II	2 lb	PRE	101	83	85	88	95
Hornet	2.4 oz	POST					
Banvel	0.5 pt						
Dual II	2 lb	PRE	89	78	85	88	95
Scorpion III	0.21 lb	POST					
Scorpion III	0.21 lb	POST	108	80	90	92	95
Accent	0.66 oz						
Untreated			5	0	0	0	0
$LSD_{0.05}$			27	15	13	9	3

EVALUATION OF SOYBEAN HERBICIDES

Brian H. Marsh

Summary

Selected broadleaf and grass herbicides for soybean were evaluated. Several new herbicides were compared to other selected herbicide combinations for weed control and phytotoxicity. Lack of early season control of grass weed resulted in reductions in grain yield. Roundup in combination with other herbicides provided adequate weed control. However, the Roundup Ready soybean variety did not yield as well as the other variety used in this test.

Procedures

Preplant-incorporated (PPI) treatments were applied in 15 gal water/a on May 21 and incorporated with one pass of a John Deere Mulch Master. Preemergence (PRE) treatments were applied on the same day following the tillage. Macon soybeans were planted on May 22 at 140,000 seeds/a in 30-inch rows. Asgrow 3601 soybeans were planted in the Roundup treatment plots. Postemergence (POST) treatments were applied on June 23. The soil had a pH of 6.8 and 2.7% organic matter. Plots were 10 ft by 30 ft. Evaluations for weed control and phytotoxicity were made on July 14 and August 4. Grass weed species rated were giant foxtail and large crabgrass. Broadleaves included velvetleaf and redroot pigweed. Plots were harvested on October 20 with a small plot combine.

Results

Excellent weed control was obtained with all of the preplant herbicide combinations. This resulted in very good grain yields. The total POST or PRE/POST combination treatments gave less than optimum grass weed control. The poor grass weed control early in the growing season (less than 90%) and less than normal rainfall combined to produced lower yields. The differences in grass control had the dominant effect on grain yield. Phytotoxicity was not observed from any treatment.

Good weed control was obtained with the Roundup combinations. The single Roundup post application controlled the weeds early in the season. However, the dry weather limited soybean growth and canopy closure. This allowed for another flush of weeds. A second application was warranted but not done. Yield potential for this variety of Roundup Ready soybean was not as great as that for the other soybean variety used in the trial. Thorough weed control is essential for optimum grain yield.

Funded in part by Dow AgroSciences

Table 8. Effects of soybean herbicides on grain yield and weed control. Cornbelt Experiment Field, 1997.

Treatment	Rate	Timing	Yield	Grasses 7/14	Grasses 8/4	Broadleaves 7/14	Broadleaves 8/4
	/a		bu/a	% control			
Broadstrike SF + Dual	2.2 lb	PPI	51	99	99	99	99
Broadstrike SF + Dual	2.2 lb	PRE	53	99	99	99	99
Broadstrike SF+Treflan	0.91 lb	PPI	53	99	99	99	96
FirstRate	0.03 lb	PRE	53	99	99	98	98
Treflan	1 lb						
FirstRate	0.04 lb	PRE	53	98	99	99	98
Treflan	1 lb						
FirstRate	0.03 lb	PRE	55	99	99	98	99
Prowl	1.25 lb						
FirstRate	0.04 lb	PRE	54	97	98	96	99
Prowl	1.25 lb						
FirstRate	0.02 lb	POST	34	85	98	75	99
Blazer	0.25 lb						
Select	6 oz						
Dual II	2 lb	PRE	40	89	98	86	99
FirstRate	0.02 lb	POST					
Pinnacle	0.002						
Dual II	2 lb	PRE	50	93	98	92	98
FirstRate	0.02 lb	POST					
Reflex	0.18 lb						
Dual II	2 lb	PRE	44	84	98	85	98
FirstRate	0.02 lb	POST					
Treflan	1 lb	PPI	38†	96	93	96	77
Roundup	0.56 lb	POST					
Broadstrike+Treflan	0.91 lb	PPI	39†	99	99	99	99
Roundup	0.56 lb	POST					
FirstRate	0.03 lb	PRE	34†	99	90	90	90
Roundup	0.56 lb	POST					
FirstRate	0.02 lb	POST	41†	86	98	93	97
Roundup	0.56 lb						
Roundup	0.56 lb	POST	21†	96	96	73	67
$LSD_{0.05}$			12	11	3	13	3

EAST CENTRAL KANSAS EXPERIMENT FIELD

Introduction

The research program at the East Central Kansas Experiment Field is designed to enhance the area's agronomic agriculture. Specific objectives are: (1) to identify the top performing varieties and hybrids of wheat, corn, grain sorghum, soybean, and oat; (2) to determine the amount of tillage necessary for optimum crop production; (3) to evaluate weed control practices using chemical, non-chemical, and combination methods; and (4) to test fertilizer rates and placement methods for crop efficiency and environmental effects.

Soil Description

Soil on the field's 160 acres is Woodson and is derived from old alluvium. The terrain is upland, level to gently rolling. The surface soil is dark, gray-brown, somewhat poorly drained, silt loam to silty clay loam with a slowly permeable, clay subsoil. Water intake is slow, averaging less than 0.1 inch per hour when soil is saturated. This makes the soil susceptible to sheet erosion.

1997 Weather Information

Precipitation during 1997 totaled 40.59 inches, which was 3.38 inches above the 29-yr average (Table 1). February was a wet month with moisture almost three and a half times greater than normal. Moisture in May was one and a half times greater than normal. June had less than half the normal rainfall. July, August, and September were above-average in moisture. Overall, moisture availability during the 1997 growing season was favorable.

The 1997 growing season was 8 days shorter than average, with 178 frost-free days compared with the 185-day average. The last 32 F degree or lower temperature in the spring was on May 1 (average, April 18) and the first killing frost in the fall was on October 27 (average, October 21).

January was the coldest month, with temperatures below 10 degrees on 11 days. January 28 was the coldest day; the low temperature was 12 below zero, and the high was 18 degrees.

Table 1. Precipitation at the East Central Experiment Field, Ottawa, inches.

Month	1997	29-Yr. Avg.	Month	1997	29-Yr. Avg.
January	0.83	1.01	July	3.82	3.66
February	4.15	1.22	August	4.48	3.57
March	1.34	2.62	September	4.82	3.73
April	3.93	3.48	October	3.15	3.45
May	7.58	5.33	November	1.96	2.40
June	2.33	5.26	December	2.20	1.48
Annual Total				40.59	37.21

PERFORMANCE TRIAL OF DOUBLE-CROPPED SOYBEAN VARIETIES

Keith A. Janssen and Gary L. Kilgore

Summary

Twelve soybean varieties were evaluated for double-cropped performance following winter wheat at the East Central Experiment Field, Ottawa during 1997. Maturity groups included III, IV, and V. Growing conditions were better than average with good moisture. Grain yields ranged from 17 to 25 bu/a. Group III and IV maturities had the highest average yields.

Introduction

Double-cropped soybean is a potentially profitable crop after small grain but is risky because of variable moisture at planting, dry summer weather, and possible early frost. Selection of varieties for double-cropped plantings in the past have been based mainly on full-season soybean performance. This study evaluates variety performance under double-cropped conditions. Generally, varieties that make most use of the double-cropping season, endure heat and moisture stress, set first pods fairly high, and tolerate cool night temperatures do best.

Procedures

Twelve soybean varieties were planted July 10, 1997 in 30-inch row widths following winter wheat. The soybeans were planted no-till. Soil moisture was good, and emergence was satisfactory. Roundup herbicide was applied before crop emergence, and the soybeans were cultivated once. Rainfall amounts after planting were: July 2.85 in., August 4.48 in., September 4.82 in., October 3.15 in. and November 2.40 in. The soybean crop was never stressed visibly for moisture. The first killing frost was on October 27, 1997, a week later than the average frost date. Harvest was on November 27.

Results

Soybean yields ranged from 17 to 26 bu/a with a test average of 21 bu/a (Table 2). This average was 1 bu/a lower than the test average for 1996 and 6 bu/a lower than the test average for 1995. Plant height varied with variety from 19 to 29 inches, and pod height from 3.7 to 7.0 inches. The group V varieties, Manokin and KS5292, were injured by frost. Group III and IV maturities had the highest average yield (22 bu/a), followed by group V (19 bu/a). The varieties in the top statistical yield group in 1997 were Delange 454, Flyer, Hogemeyer 471, KS4694, Pioneer 8393, and Pioneer 9452. Midland 8393 had the highest 2-yr and 3-yr average yields.

Table 2. Double-cropped soybean variety performance test, East Central Kansas Experiment Field, Ottawa.

		Yield			1997		
Variety	Maturity Group	1997	2-Yr Avg	3-Yr Avg	Maturity[1] (Freeze on 10-27)	Plant Height	Pod[2] Height
		bu/a @ 13%			month/day	inch	inch
Delange 410	IV	20.2	21.3	--	10-27	23	4.0
Delange 454	IV	22.7	--	--	10-27	24	4.7
Flyer	IV	21.5	21.9	24.0	10-27	23	4.3
Hoegemeyer 371	III	17.0	--	--	10-25	19	4.3
Hoegemeyer 471	IV	23.1	--	--	10-27	24	5.0
KS4694	IV	23.7	22.2	--	10-27	24	5.3
KS5292	V	17.5	19.2	19.9	froze	24	6.0
Manokin	V	20.9	20.9	21.0	froze	29	7.0
Midland 8393	III	21.0	22.7	25.3	10-26	25	4.3
Pioneer 9395	III	25.8	--	--	10-26	23	4.0
Pioneer 9421	IV	21.0	--	--	10-27	24	4.7
Pioneer 9452	IV	22.8	--	--	10-27	22	3.7
LSD 0.05		4.6			1.0	3	1.9
CV %		12.7			0.7	6.6	22.1

[1]Maturity is the date on which 95% of the pods have ripened (browned).
[2]Distance from the ground to the bottom of the lowest pod.

EFFECTS OF SUBSOILING ON PERFORMANCE OF CORN AND SOYBEAN

Keith A. Janssen

Summary

Questions are being asked about the benefits of subsoiling on claypan soils. The effects of deep subsoil ripping, shallower chisel plowing, and no-preplant tillage were evaluated on corn and soybean at the East Central Experiment Field during 1996 and 1997. Corn grain yields for 1997 ranged from 135 to 142 bu/a. Soybean yields ranged from 43 to 47 bu/a. Yield was not affected statistically by the different tillage treatments. Two-year, average results also showed few yield differences for the tillage treatments. No-till yield has been equal to that with the most frequent subsoil tillage. Moisture in both years was above average and might have limited the subsoil response. Additional years of testing are needed under drier conditions to fully evaluate the benefits of subsoiling.

Introduction

Extensive acreage of upland soils in the east-central and southeast areas of Kansas have naturally occurring dense clay subsoils. These slowly permeable subsoils restrict drainage, limit depth of rooting, and limit crop-available moisture. As a result, crop yield is restricted. Various deep tillage practices have been used to attempt to modify these claypan soils and benefit yield. Some farmers deep chisel or subsoil their fields every year, others every other year, and some on a less regular basis. In most of these soils, the predominant clay is montmorillonite, which expands and contracts with wetting and drying. Also, freeze-and-thaw cycles in most winters naturally loosen these soils to a depth of 6 to 8 inches or more. These naturally occurring shrink-swell processes should alleviate most of the compaction resulting from fertilization, planting, spraying, and harvesting. Consequently, the need for subsoiling is being questioned. Another question is, whether some crops are affected more than others by subsoiling. This study compares various subsoil tillage practices and timings with chisel plow and no preplant tillage for effects on corn and soybean yields.

Procedures

The experiment was started in 1996 and was continued during 1997. The location was at the East Central Experiment Field on a Woodson silt loam soil that has a dense clay subsoil (fine montmorillonitic, thermic, Abruptic Argiaquolls). Tillage treatments were no-preplant tillage; a straight-shank chisel plowing (5-7 in. depth) every year; and subsoil tillage at an 8-10 in. depth yearly, every other year, and every 3 years. Treatments were established in separate blocks for corn and for soybean. All tillage plots including the no-till plots were row-crop cultivated once for weed control. Also, all tillage plots except the no-till plots were field cultivated before planting. Corn (Pioneer 3394) was planted on April 25 in one block, and soybean (KS4694) was planted on June 20 in the other block. These crops are being rotated back and forth each year. Subsoil tillage and chisel plow treatments were performed on February 20, 1996 and on April 25, 1997. A mixture of 30 gal. 28-0-0 and 15 gal. 7-21-7 liquid fertilizer/a was coulter knifed on April 25, 1997 for corn. No fertilizer was applied for soybean. Rainfall amounts after establishing the 1997 tillage treatments were: April 0.02 in., May 7.58 in. June 2.33 in., July 3.82 in., August 4.48 in., September 4.82 in., and October 3.15 in. The corn and soybean crops were never stressed visibly for moisture.

Results

Corn grain yields ranged from 135 to 142 bu/a with a test average of 138 bu/a (Table 3.) Yields for all tillage and subsoil treatments were statistically not different. Also, the no-till corn had no visual symptoms of nitrogen (N) deficiency in in 1997. In 1996, corn in the no-till treatment was reduced because of insufficient N. We increased the N application rate in all treatments by 30 lb/a in 1997.

Soybean yields ranged from 43 to 47 bu/a with a test average of 45 bu/a. Soybean yield also was not affected significantly by the subsoil treatments. Moisture during the 1996 and the 1997 years was above average. Rainfall during the late vegetative and grain fill periods was timely in both years. Under drier conditions, the effects of subsoiling might be greater. Consequently, more years of testing are needed with more normal moisture conditions to truly evaluate the effects of subsoiling. Plans are to repeat this study in 1998.

Acknowledgment

Appreciation is expressed to John Wray, Ottawa, KS for providing the subsoiler and the tractor for establishing the subsoil treatments

Table 3. Subsoiling effects on corn and soybean yield, East Central Kansas Experiment Field, Ottawa.

	Yield			
	Corn		Soybean	
Tillage System and Frequency	1997	2-Yr Avg	1997	2-Yr Avg
	bu/a			
No-till[1]	138	133	43	45
Chisel[2] (every year)	135	138	45	46
Subsoil[3] (every year)	137	144	45	46
Subsoil (every other year)	139	140	47	47
Subsoil (every third year) same as tmt. above	142	144	46	47
LSD.05	ns		ns	
CV %	3.1		3.6	

[1]With one in-season cultivation.
[2]5-7 inch depth.
[3]8-10 inch depth.

PHOSPHORUS LOSSES IN RUNOFF WATER AS AFFECTED BY TILLAGE AND PHOSPHORUS FERTILIZATION[1]

Keith A. Janssen, Gary M. Pierzynski, and Phil L. Barnes

Summary

Runoff from cropland can add to the nutrient enrichment and eutrophication of surface water bodies. Research was continued during 1997 to determine which tillage systems and which methods of applying P fertilizer will result in the least P losses in runoff. The tillage systems evaluated were a chisel-disk-field cultivate system, a ridge-till system, and a no-till system. Fertilizer treatments evaluated were a P check, 50 lb/a P_2O_5 surface broadcast, and 50 lb/a P_2O_5 deep-banded. Runoff from natural rainfall was collected during three periods before and after grain sorghum fertilization and planting, 1995-1997. Averaged across all runoff events over 3 years, most runoff occurred with ridge-till and no-till. Chisel-disk produced the least runoff. Soil and sediment P losses in the runoff water followed the pattern chisel-disk > ridge-till > no-till. Soluble P losses were highest with no-till followed by ridge-till and chisel-disk. This was largely because of the nonincorporated, broadcast P fertilizer in the conservation tillage systems. Total bioavailable P losses closely paralleled soluble P losses because of the significant contribution of soluble P to those total losses. Grain yield was not affected by the tillage systems. Deep-banded P increased grain sorghum yield by an average 7 bu/a compared to broadcast P.

Introduction

Phosphorus (P) in runoff from cropland can contribute to the nutrient enrichment in lakes, streams, and rivers. High levels of P in water accelerates eutrophication of surface water bodies, producing water that has undesirable odor and taste for drinking and recreation. Excess P in surface water is a problem in the Hillsdale Lake watershed in east-central Kansas. All stakeholders in the watershed, including farmers, are being urged to reduce nonpoint sources of P entering surface water (Big Bull Creek Water Quality Incentive Project). Losses of P from conventional-tilled cropland are mostly in the form of sediment P, with smaller amounts dissolved in the runoff water. Consequently, soil erosion control practices and use of conservation tillage systems have been encouraged. Several recent studies, however, have indicated that losses of soluble forms of P increase with conservation tillage systems because of nonincorporated P fertilizer and decomposition of crop residues on the soil surface. Because soluble P is 100% bioavailable, even small losses can impact water quality. Coupled with the expected greater-than-normal runoff, because of an abundance of slowly permeable soils in eastern Kansas, this might mitigate some or all of the sediment P reduction benefits associated with conservation tillage. Consequently, the best P-management practices in P-sensitive watersheds may require soil erosion control practices and subsurface placement of P fertilizer. Deeper placement would put the fertilizer P below the critical surface-water soil interface and mixing zone (approximately the top 1 inch of soil, where most P losses originate). Deeper placement also might benefit crop yield, because P would be better in a location for root uptake during dry surface soil conditions.

[1]This research was funded partially by the Kansas Fertilizer Research Fund.

The objective of this study was to evaluate the effects of different tillage and P fertilization practices on P losses in runoff water.

Procedures

The study was conducted at the East Central Kansas Experiment Field, Ottawa, on a 1.0 to 1.5 % slope, somewhat poorly drained, Woodson silt loam soil (fine, montmorillonitic, thermic, Abruptic Argiaquolls). This site represents prime farmland in this region of Kansas. The tillage systems evaluated were chisel-disk-field cultivate (chisel in the fall or late winter, disk in the early spring, and field cultivation immediately prior to planting); ridge-till (with ridges formed in the fall or late winter); and no-till. Included as subplots within these tillage systems were three P fertilizer treatments, a check with no P fertilizer applied, 50 lb/a P_2O_5 surface broadcast, and 50 lb/a P_2O_5 deep-banded (coulter-knifed) at approximately a 4-inch depth on 15-inch centers. This rate of P application was for two crops, grain sorghum and the following year's soybean crop. Bray P-1 soil test P at the start of this study was in the medium to high range. Liquid 7-21-7 fertilizer was the source of P for all fertilizer applications. Surface broadcast P in the chisel-disk-field cultivate system was incorporated with the field cultivation before planting. In the ridge-till and no-till systems, broadcast P was not incorporated except for that covered by the planting operation. All runoff data were collected in the sorghum portion of the crop rotation on the previous year's soybean stubble. Runoffs were collected from five events in 1995, six events in 1996, and seven events in 1997, spanning the period before and after P fertilizer application and grain sorghum planting. This period is considered most susceptible to erosion and P losses. Runoff was collected by delimiting 50 sq. ft. areas (5 ft x 10 ft) with metal frames driven approximately 3 inches deep into the ground in each 10 x 50 ft plot. The runoff from within these frames was directed to a sump and then pumped though a series of dividers (five spitters) to determine the runoff volume and to obtain a composite sample of the runoff. Total, sediment, bioavailable particulate, soluble, and total bioavailable P losses in the runoff water were measured in all years.

Rainfall amounts and dates on which runoff were collected are shown in Table 4. The P fertilizer treatments were applied on 11 July 1995, 21 June 1996, and 7 June 1997. Pioneer 8310 grain sorghum was planted in 1995, and Pioneer 8500 grain sorghum in 1996 and 1997.

Results

<u>Runoff Volume and Soil Loss</u>

The amount of runoff varied with rainfall events, tillage systems, and years. Generally, most runoff occurred with the largest and most intense rainfall events. However, moisture and infiltration differences between tillage systems preceding the rainfall events also influenced runoff amounts. When averaged across all rainfall events and years and across all fertilizer treatments, runoff was highest with the ridge-till and no-till systems and lowest with chisel-disk (Figure 1). This was because tillage in the chisel-disk system dried and loosened the soil prior to rainfall events, which increased infiltration and reduced runoff. The average amount of rainfall that ran off were 18 % for the chisel-disk system, 32 % for the ridge-till system, and 30 % for the no-till system. These runoff amounts differ from some reports of up to 50% reduction and more in runoff with conservation tillage systems. The difference here is that this soil has a dense clay subsoil and is somewhat poorly drained.

Soil loss in the runoff water (Figure 2) generally paralleled rainfall and runoff amounts, but intensity and timing of individual rainfall events also influenced soil losses. Overall, soil losses in the runoff water were highest in the chisel-disk system. Sediment losses generally followed the pattern chisel-disk > ridge-till > no-till, suggesting that full-width surface soil loosing and residue incorporation results in greater soil losses than partial (shaving of the ridge at planting in the ridge-till system) or very limited soil and residue disturbance (coulter at planting in no-till). Averaged across all runoff events and years, soil losses were 0.8 ton/a for the chisel-disk system, 0.6 ton/a for the ridge-till system, and 0.3 ton/a for the no-till system. These are reductions of approximately 25 and 60 % , respectively, for the ridge-till and no-till tillage systems compared to the chisel-disk system. Although these amounts are for only a part of the crop year, all are below the T (tolerance) level of 4 ton/a necessary to maintain productivity of this soil.

Phosphorus Losses

Losses of P in the runoff water were influenced by rainfall events, tillage system, fertilizer practices, and years. Total P losses when summed across all runoff events and years (Figure 3) were highest with the chisel-disk and ridge-till systems and lowest for no-till. These differences generally paralleled soil losses. Most of the total P losses were in the form of sediment P losses (Figure 4). Only a small portion of the sediment P losses, however, is bioavailable or effective P. This is shown by the bioavailable particulate P losses in Figure 5. Roughly 5% of the sediment P losses was bioavailable.

Losses of soluble P varied with tillage systems and interacted with P fertilizer treatments. Averaged across all runoff events and across all years, soluble P losses (Figure 6) were smallest for chisel-disk, intermediate for ridge-till and highest for no-till . In the chisel-disk system, where broadcast P was incorporated, losses of soluble P were negligible compared to those with no P fertilizer application. In the ridge-till system, where the fertilizer P was broadcast on the soil surface and was covered partially by the shaving of the ridge at planting, losses of soluble P increased moderately compared to those with no P fertilizer application. In the no-till system, where nearly all of the broadcast P was left exposed on the soil surface, soluble P losses increased nearly sixfold compared to those with no P fertilizer applied. Knifed P, on the other hand, caused significantly lower soluble P losses because of its subsurface placement. Total bioavailable P losses (Figure 7) show the same general patterns as soluble P losses. This is because nearly all of the bioavailable P losses were in the form of soluble P. The losses of soluble P in all years occurred mainly during the first couple of runoff events after P fertilizer application (data not shown) and then diminished with successive runoff events. These data suggest that in conventional-till systems, broadcast P also should be incorporated before runoff occurs; otherwise soluble P losses could be similar to those with surface P applications in conservation-tillage systems.

Grain Yield

Grain yield was not affected by the tillage treatments (Table 5). Application and placement of P fertilizer significantly affected yield. Deep-banded P produced an average grain sorghum yield 7 bu/a higher than that with broadcast P and 11 bu/a higher than that for the P check. This occurred even though the soil test P was in the medium to high P test range. These yield benefits should provide an incentive for crop producers to deep-band P fertilizer, which also will reduce P runoff losses.

Conclusions

These data indicate that in conservation-tillage systems, fertilizer P should be subsurface applied. In conventional-till systems, broadcast P should be incorporated before runoff occurs. If these practices are followed, then bioavailable P losses from cropland should be reduced.

Table 4. Rainfall amounts and runoff collection dates, Ottawa, KS.

1995		1996		1997	
Rainfall	Date	Rainfall	Date	Rainfall	Date
0.80	7-04-95	1.75	5-26-96	1.52	5-18-97
1.94	7-20-95	2.45	6-06-96	1.40	5-25-97
1.68	7-31-95	2.02	6-16-96	1.40	5-26-97
0.72	8-03-95	1.85	7-04-96	1.40	5-30-97
1.10	8-15-95	1.28	7-08-96	0.97	6-13-97
		2.04	7-22-96	0.98	6-16-97
				1.10	7-13-97

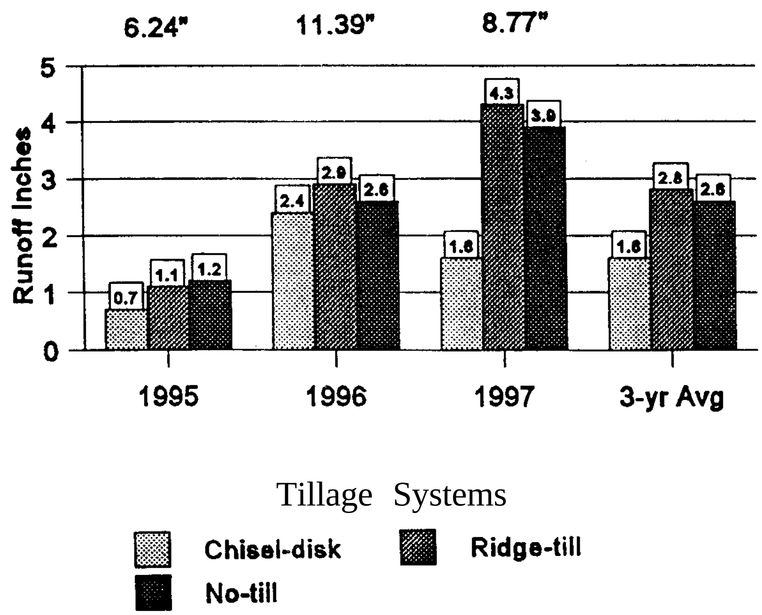


Figure 1. Effects of tillage and rainfall on amount of runoff in 3 years. Ottawa.

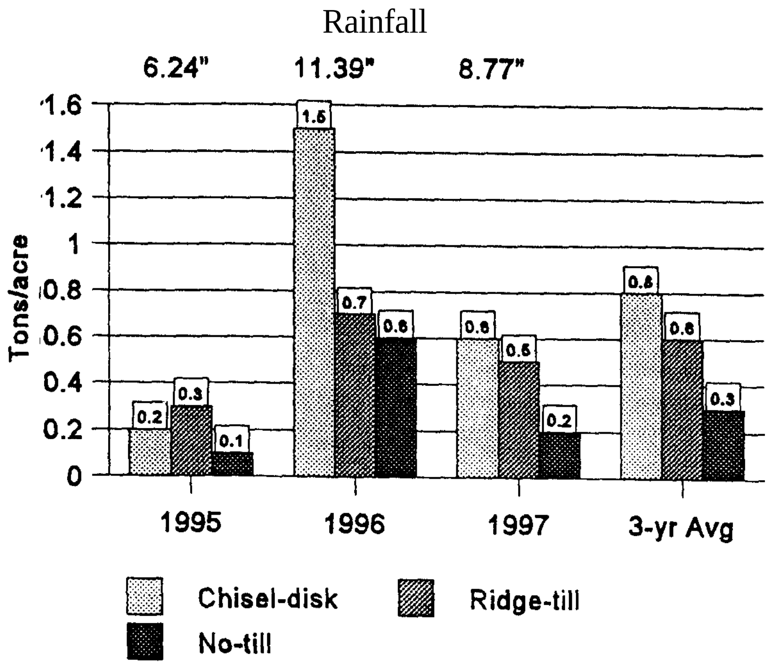


Figure 2. Effects of tillage and rainfall on soil losses in 3 years, Ottawa, KS.

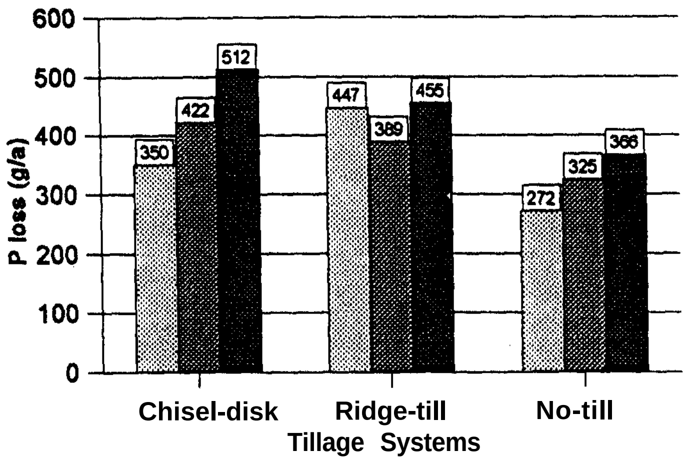


Figure 3. Effects of tillage and P rate/placement on total P losses (3-year average), Ottawa, KS.

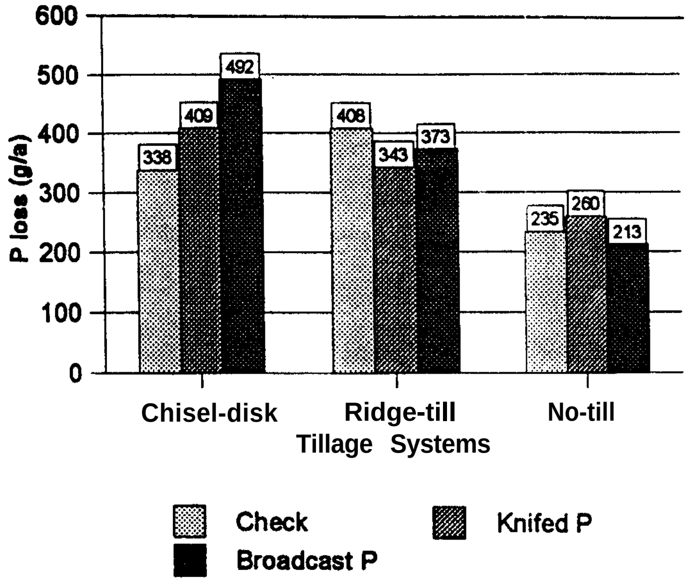


Figure 4. Effects of tillage and P rate/placement on sediment P losses (3-year average), Ottawa, KS.

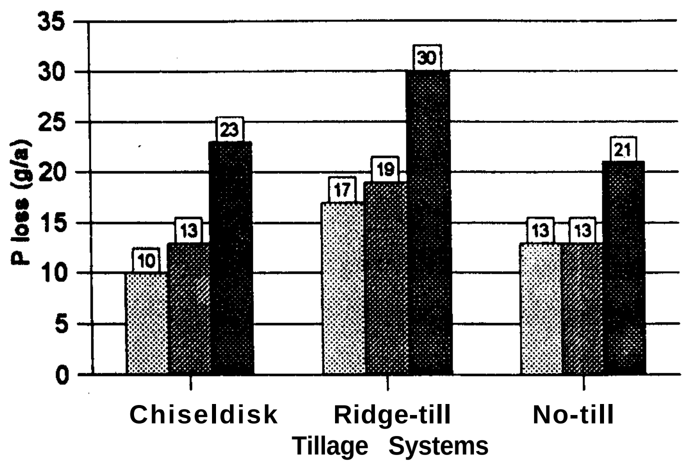


Figure 5. Effects of tillage and P rate/placement on bioavailable particulate P losses (3-year average), Ottawa, KS.

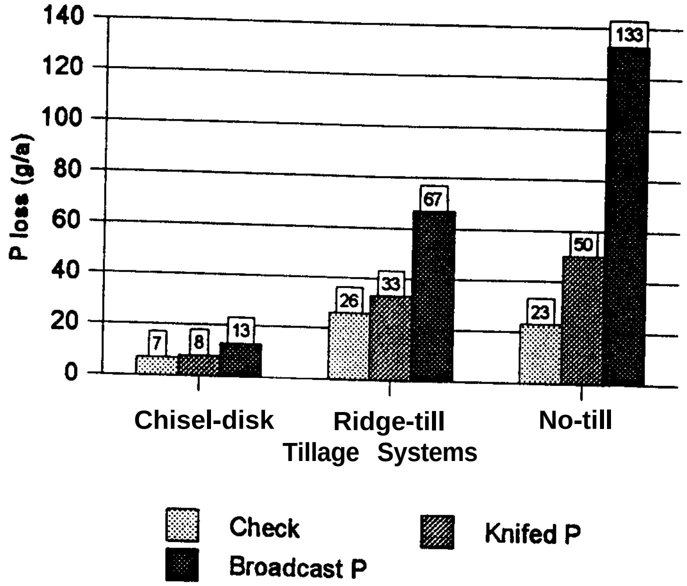


Figure 6. Effects of tillage and P rate/placement on soluble P losses (3-year average), Ottawa, KS.

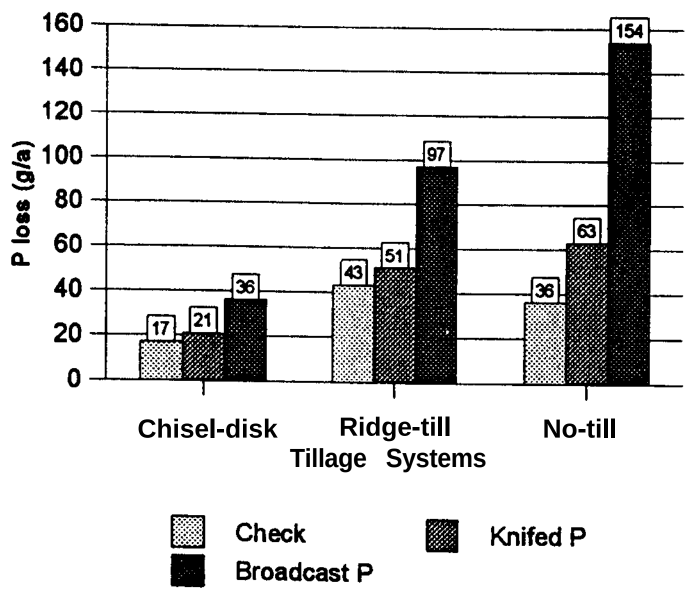


Figure 7. Effects of tillage and P rate/placement on total bioavailable P losses (3-year average), Ottawa, KS.

Table 5. Effects of phosphorus on grain sorghum yield, East Central Kansas Experiment Field, Ottawa.

Phosphorus Treatment	Yield 1995[1]	1996	1997	3-yr avg
	bu/a			
Check-no P	20	91	123	78
50 lb/a P_2O_5 broadcast	22	90	128	80
50 lb/a P_2O_5 knifed	28	102	131	87
LSD.05	3	4	3	

[1]Yield for 1995 was reduced significantly by late planting and a killing early freeze.

HARVEY COUNTY EXPERIMENT FIELD

Introduction

Research at the Harvey County Experiment Field deals with many aspects of dryland crop production on soils of the Central Loess Plains and Central Outwash Plains of central and south central Kansas and is designed to benefit directly the agricultural industry of the area. Focus is primarily on wheat, grain sorghum, and soybeans, but also includes alternative crops such as corn and oats. Investigations include variety and hybrid performance tests, chemical weed control, tillage methods, fertilizer use, and planting practices, as well as disease and insect resistance and control.

Soil Description

The Harvey County Experiment Field consists of two tracts. The headquarters tract, 75 acres immediately west of Hesston on Hickory St., is all Ladysmith silty clay loam with 0-1% slope. The second tract, located 4 miles south and 2 miles west of Hesston, is comprised of 142 acres of Ladysmith, Smolan, Detroit, and Irwin silty clay loams, as well as Geary and Smolan silt loams. All have 0-3% slope. Soils on the two tracts are representative of much of Harvey, Marion, McPherson, Dickinson, and Rice counties, as well as adjacent areas.

These are deep, moderately well to well-drained, upland soils with high fertility and good water-holding capacity. Water runoff is slow to moderate. Permeability of the Ladysmith, Smolan, Detroit, and Irwin series is slow to very slow, whereas permeability of the Geary series is moderate.

1996-1997 Weather Information

The 1996-1997 wheat growing season brought timely and, for the most part, above-normal precipitation. Soil moisture levels were favorable leading up to fall planting. Rains after mid-October ensured establishment of excellent stands. Winter injury was negligible, but a warm March followed by a plunge in temperatures to the low 20s on April 11-13 raised major concerns of possible freeze damage that did not materialize. Subsequent mild temperatures and ample moisture throughout the remainder of the spring, along with the absence or late arrival of leaf diseases, led to record high wheat yields.

For row crops as well, weather factors combined to permit production of high yields. Above-normal rainfall prevailed from April through August. Planting of some experiments was delayed because of wet conditions. Maximum and minimum air temperatures during this period averaged 5°F and 2°F below normal, respectively. Only 3 days during late spring and summer had air temperatures equal to or greater than 99°F. Sorghum Growing Degree Days were somewhat below normal throughout the July-October period. Growing Degree Days were approximately 242 fewer than normal for the entire growing season. Fortunately, an open fall season with a late arrival of freezing temperatures allowed sorghum to reach maturity. Soybeans also matured before the first fall frost in late October.

Frost occurred last in the spring on April 14 and first in the fall on October 26. This frost-free season of 195 days was about 27 days longer than normal.

Table 1. Monthly precipitation totals,inches - Harvey Co. Experiment Field, Hesston, KS.[1]

Month	N Unit	S Unit	Normal	Month	N Unit	S Unit	Normal
	1996				1997		
October	2.02	1.46	2.55	March	0.43	0.46	2.42
November	4.52	4.84	1.73	April	3.05	3.24	2.71
December	0.02	0.01	1.16	May	6.04	6.26	4.41
				June	5.85	4.88	4.67
	1997			July	4.35	5.46	2.90
January	0.16	0.06	0.67	August	4.43	3.68	3.11
February	2.35	2.18	0.87	September	3.55	3.78	3.63
Twelve-month total					36.77	36.31	30.83
Departure from normal					5.94	5.48	

[1] Hairy vetch cover crop studies and the weed control experiment in soybeans with Roundup were located at the South Unit. All other on-station experiments reported here were conducted at the North Unit.

REDUCED TILLAGE AND CROP ROTATION SYSTEMS WITH WHEAT, GRAIN SORGHUM, CORN, AND SOYBEANS

Mark M. Claassen

Introduction

Crop rotations facilitate reduced tillage practices, while enhancing disease and weed control. Long-term research at Hesston has shown that winter wheat and grain sorghum can be grown successfully in an annual rotation. Although subject to greater impact from drouth stress than grain sorghum, corn and soybeans also are viable candidates for crop rotations in central Kansas dryland systems that conserve soil moisture. Because of their ability to germinate and grow under cooler conditions, corn and soybeans can be planted earlier in the spring and harvested earlier in the fall than sorghum, thereby providing opportunity for soil moisture replenishment as well as a wider window of time within which to plant the succeeding wheat crop. This study was initiated at Hesston on Ladysmith silty clay loam to evaluate the consistency of corn and soybean production versus grain sorghum in an annual rotation with winter wheat and to compare these rotations with monoculture wheat and grain sorghum systems.

Procedures

Three tillage systems were established for continuous wheat; two for each row crop (corn, soybeans, and grain sorghum) in annual rotation with wheat; and two for continuous grain sorghum. Each system, except no-till, included secondary tillage as needed for weed control and seedbed preparation. Wheat in rotations was planted after each row-crop harvest without prior tillage. The following procedures were used.

<u>Wheat after corn</u>
WC-NTV = No-till after V-blade (V-blade, sweep-treader, mulch treader) for corn
WC-NTNT = No-till after No-till corn

<u>Wheat after sorghum</u>
WG-NTV = No-till after V-blade (V-blade, sweep-treader, mulch treader) for sorghum
WG-NTNT = No-till after No-till sorghum

<u>Wheat after soybeans</u>
WS-NTV = No-till after V-blade -blade, sweep-treader, mulch treader) for soybeans
WS-NTNT = No-till after No-till soybeans

<u>Continuous wheat</u>
WW-B = Burn (burn, disk, field cultivate)
WW-C = Chisel (chisel, disk, field cultivate)
WW-NT = No-till

<u>Corn after wheat</u>
CW-V = V-blade (V-blade, sweep-treader, mulch treader)
CW-NT = No-till

<u>Sorghum after wheat</u>
GW-V = V-blade (V-blade, sweep-treader, mulch treader)
GW-NT = No-till

<u>Soybeans after wheat</u>
SW-V = V-blade (V-blade, sweep-treader, mulch treader)
SW-NT = No-till

Continuous sorghum

SS-C = Chisel (chisel, sweep-treader, mulch treader)
SS-NT = No-till

Continuous wheat no-till plots were sprayed with Roundup Ultra + ammonium sulfate (AS) at 1.0 lb ai/a + 2.6 lb/a in late July. Roundup Ultra was applied at 0.5 lb ai/a again in mid-October for cheat and volunteer wheat control. Variety 2137 was planted on October 19 in 8 in. rows at 75 lb/a with a CrustBuster no-till drill equipped with double-disk openers. Wheat was fertilized with 90 lb N/a and 32 lb P_2O_5/a applied at planting as preplant, broadcast ammonium nitrate and in-furrow diammonium phosphate, respectively. Weeds were controlled with Bronate (0.75 lb ai/a) in rotation plots and Bronate + Glean + nonionic surfactant (0.5 lb ai/a + 0.25 oz ai/a + 0.25% Pen-A-Trate II) in continuous wheat plots. Wheat was harvested on July 5, 1997.

No-till corn after wheat plots received the same Roundup treatments as WW-NT during the summer and fall. CW-V plots were tilled twice with a V-blade and twice with a sweep-treader between wheat harvest and corn planting. Corn was fertilized with 100 lb/a N as ammonium nitrate broadcast prior to planting. An additional 14 lb/a N and 37 lb/a P_2O_5 were banded 2 inches from the row at planting. A White no-till planter with double-disk openers on 30 in. centers was used to plant Golden Harvest H-2404 at approximately 23,000 seeds/a on April 3, 1997. Weeds were controlled with preemergence application of Partner 65 DF + AAtrex 90 DF (2.5 + 0.5 lb ai/a). Row cultivation was not required. Corn was harvested on September 9.

No-till sorghum after wheat plots were treated twice as previously noted with Roundup during the summer and fall. Additionally, GV-NT and GG-NT plots were sprayed with Roundup Ultra + 2,4-D_{LVE} + AS (1.0 + 0.17 lb ai/a + 3.4 lb/a) in early May. SW-V plots were tilled twice with a V-blade, twice with a sweep-treader, and once with a mulch treader during the fallow period between wheat harvest and sorghum planting. SS-C plots were tilled once with a chisel, twice with a sweep-treader, and once with a mulch treader. Sorghum was fertilized like corn, but with 90 lb/a total N. Pioneer 8500 treated with Concep III safener and Gaucho insecticide was planted at 38,100 seeds/a in 30-in. rows on May 6. Preemergence application of Partner 65 DF at 2.5 lb ai/a + AAtrex 90 DF at 0.5 (rotation) or 1.0 (continuous sorghum) controlled weeds during the season without row cultivation.

Field procedures for soybeans in the respective tillage systems were basically the same as for grain sorghum. However, soybeans received only starter fertilizer, and weeds were controlled preemergence with Partner 65 DF + Scepter 70 DG (2.5 + 0.12 lb ai/a). Resnik soybeans were planted at 8 seeds/ft in 30-in. rows on May 6 and harvested on October 6.

Results

Wheat

Crop residue covers after planting ranged from 48 to 80% in wheat after corn and sorghum but averaged only 33% in wheat after soybeans (Table 2). In continuous wheat, residue covers ranged from 5% in burned plots to 80% with no-till. Wheat stands were good but slightly lower in WG-NT and WW-NT.

Control of cheat and broadleaf weeds was generally excellent. However, a previous cheat infestation resulted in somewhat poorer cheat control in WG-NTNT.

Precipitation pattern during the fall as well as throughout the remainder of the growing season was very favorable for wheat, particularly in rotations. However, wheat after sorghum appeared less robust than wheat following corn or soybeans. Although wheat was fertilized uniformly, average whole-plant N at late boot-early heading stage was significantly lower following sorghum than after corn, soybean, or wheat. Record wheat yields of more than 80 bu/a were harvested. Wheat after corn ranked highest, followed by wheat after soybeans, and wheat after sorghum. Prior tillage system did not affect wheat after corn or soybean. However, wheat in WG-NTV produced 16.3 bu/a more than that in WG-NTNT. Continuous wheat yielded more than wheat after sorghum but less than wheat after corn or soybeans. Yield of WW-C averaged 17.7 bu/a more than that of WW-NT.

Row Crops

Crop residue covers for row crops following wheat averaged 38% for V-blade and 71% for no-till systems (Table 3). Corn in the V-blade system tended to have a slightly higher plant population, earlier maturity, higher leaf N content, more ears/plant, and larger grain yield than corn with no-till.

In sorghum after wheat, tillage system had no effect on stands. But, sorghum in GW-V had a slightly higher flag-leaf N content and larger number of heads/plant, as well as somewhat earlier maturity than that in GW-NT. Nevertheless, the tillage effect on yield of grain sorghum after wheat was not significant. Continuous sorghum showed little or no tillage effect on any of the crop responses measured. Notably, however, continuous sorghum had a lower leaf N content, lower plant height, fewer heads/plant, and yielded an average of 30.6 bu/a less than sorghum after wheat.

Soybeans after wheat was not affected by tillage system but produced excellent yields averaging 50.4 bu/a.

Table 2. Row crop rotation and tillage effects on wheat, Harvey County Experiment Field, Hesston, KS, 1997.

Crop Sequence[1]	Tillage System	Crop Residue Cover	Yield	Test Wt	Stand	Heading	Plant N[5]	Cheat Control
		%[2]	bu/a[3]	lb/bu	%	date[4]	%	%[6]
Wheat-corn	V-blade	67	83.6	58.5	95	14	1.09	99
(No-till)	No-till	58	89.2	59.0	95	15	1.23	99
Wheat-sorghum	V-blade	48	52.8	58.4	95	15	0.86	94
(No-till)	No-till	80	36.5	57.9	86	17	1.09	81
Wheat-soybeans	V-blade	34	78.9	59.0	97	14	1.28	100
(No-till)	No-till	32	83.9	59.2	92	15	1.14	100
Continuous wheat	Burn	5	74.2	58.4	95	14	1.23	100
	Chisel	17	76.9	58.4	100	14	1.29	100
	No-till	80	59.2	58.0	89	16	1.29	97
LSD .05		13	6.4	0.54	6.7	1.3	0.18	7
Main effect means: Crop Sequence								
Wheat-corn		63	86.4	58.8	95	15	1.16	99
Wheat-sorghum		64	44.7	58.1	90	16	1.00	87
Wheat-soybeans		33	81.4	59.1	95	14	1.21	100
Continuous wheat		49	68.1	58.2	94	15	1.29	98
LSD .05		10	4.7	0.36	3.8	0.9	0.13	5
Rotation Tillage system								
No-till/V-blade		50	71.8	58.6	96	14	1.08	97
No-till/no-till		56	69.9	58.7	91	15	1.15	93
LSD .05		NS	NS	NS	3.1	0.6	NS	NS

[1] All wheat planted no-till after row crops. Crop sequence main effect means exclude the continuous wheat - burn treatment. Tillage main effect means exclude all continuous wheat treatments.
[2] Crop residue cover estimated by line transect after planting.
[3] Means of four replications adjusted to 12.5% moisture.
[4] Date in May on which 50% heading occurred.
[5] Whole-plant nitrogen levels at late boot to early heading.
[6] Visual rating of cheat control in June.

Table 3. Wheat rotation and reduced tillage effects on corn, grain sorghum, and soybeans, Harvey County Experiment Field, Hesston, KS, 1997.

Crop Sequence	Tillage System	Crop Residue Cover	Yield	Test Wt	Stand	Maturity[3]	Ears or Heads/ Plant	Leaf N[4]
		%[1]	bu/a[2]	lb/bu	1000's/a			%
Corn-wheat	V-blade	41	121.8	60.2	23.3	96	1.23	2.37
	No-till	70	102.3	59.7	21.3	72	1.12	2.09
LSD .05		7	NS	NS	NS	16	NS	NS
LSD .15		-	12.7	0.5	1.8	--	0.11	0.28
Sorghum-wheat	V-blade	37	116.0	59.4	33.5	74	1.79	2.83
	No-till	75	121.2	59.4	34.0	78	1.60	2.57
LSD .05		8	NS	NS	NS	1	0.15	0.22
LSD .15		-	NS	NS	NS	-	----	----
Contin. sorghum	Chisel	37	90.4	58.6	34.7	77	1.25	2.12
	No-till	60	85.6	58.5	35.2	78	1.21	2.26
LSD .05[5]		8	24.8	----	NS	1.1	0.15	0.22
LSD .15[5]		--	----	0.76	NS	0.8	----	----
Soybeans-wheat	V-blade	36	49.6	57.3	----	19	33	----
	No-till	68	51.2	56.8	----	19	32	----
LSD .05		24	NS	NS		NS	NS	
LSD .15		--	NS	0.5		NS	NS	
Main effect means for sorghum:								
<u>Crop sequence</u>								
Sorghum-wheat		56	118.6	59.4	33.8	76	1.69	2.70
Contin. sorghum		48	88.0	58.5	34.9	77	1.23	2.19
LSD .05		5	17.5	0.8	NS	0.8	0.11	0.15
<u>Tillage system</u>								
V-blade/chisel		37	103.2	59.0	34.1	75	1.52	2.47
No-till/no-till		67	103.4	58.9	34.6	78	1.41	2.42
LSD .05		5	NS	NS	NS	0.8	0.11	NS

[1] Crop residue cover estimated by line transect after planting.
[2] Means of four replications adjusted to 12.5% moisture (corn, sorghum) or 13% moisture (soybeans).
[3] Maturity expressed as follows: corn - percentage of plants silked on June 30; grain sorghum - number of days from planting to half bloom; soybeans - day in September on which 95% mature pod color occurred.
[4] Corn leaf opposite and below the ear at late silking.
Sorghum flag leaf at late boot to early heading.
[5] LSD's for comparisons among means for continuous sorghum and sorghum after wheat treatments.

EFFECT OF GAUCHO SEED TREATMENT ON GRAIN SORGHUM

Mark M. Claassen

Introduction

Chinch bug infestations vary considerably both regionally in south central Kansas as and locally in proximity to winter wheat fields. Use of a planting-time treatment for chinch bug control usually is not considered viable for early-planted grain sorghum, because insecticide can dissipate by the time that chinch bugs migrate from wheat to sorghum. On the other hand, in early sorghum, a planting-time insecticide may be justified because of the potential for wire worm damage associated with slower germination and emergence. For sorghum planted in the conventional range of dates in June, use of a planting-time insecticide can be more effective for chinch bug control than postemergence foliar insecticide application when adequate soil moisture is present for insecticide uptake by sorghum. The loss of granular Furadan for sorghum has further reduced the number of insecticide options for sorghum at planting. Research at Hesston was conducted to determine the effect of Gaucho seed-treatment insecticide on plant populations, early plant vigor, and yield of sorghum planted very early as well as at a conventional time in an environment where light chinch bug populations were present.

Procedures

Gaucho-treated and untreated seed from the same respective seed lots of five sorghum hybrids were planted at early (April 24) and conventional (June 27) dates. Two additional hybrids with and without Temik 15 G insecticide in furrow at planting were included for comparison in the June planting.

The experiment site had been cropped continuously to sorghum. Reduced tillage practices were used for seedbed preparation. The area was fertilized with 87 lb N/a and 32 lb P_2O_5 broadcast and incorporated in late March. Sorghum was planted about 1 in. deep at three seeds/ft (April) or 2.4 seeds/ft (June) in 30-in. rows. In the interval between the two planting dates, weeds in the unplanted area were controlled with Roundup + 2,4-D at 0.38 at 0.75 + .25 lb ai/a and without any additional tillage. Immediately after planting, the respective areas were sprayed with Ramrod 4L + AAtrex 90 DF at 4 + 1 lb ai/a. Harvesting was completed on September 18 and November 8 for sorghum in the early and conventional planting dates, respectively.

Results

In the April planting, final sorghum stands ranged from 27 to 65% of the planting rate (Table 4). Gaucho increased sorghum populations significantly for all hybrids except Mycogen 1552. The average increase across all hybrids was 6,800 plants/a. Sorghum vigor tended to increase slightly with Gaucho, but this effect was not significant for most of the hybrids. Chinch bug numbers averaged 0.7/plant in early August. Gaucho was associated with a slight overall reduction in the number of days from planting to half bloom, the number of heads/plant, lodging percentage, and grain moisture. However, these effects were minor and inconsistent among hybrids. On the other hand, yields tended to increase with Gaucho seed treatment. This increase was significant for DeKalb DK-56 and NC+ 271. The average increase across all hybrids was

13 bu/a. Gaucho did not affect the test weight of grain from early-planted sorghum.

Heavy rains 2 days after the June planting affected sorghum emergence. However, because of warm soil temperatures, sorghum emerged relatively soon, with final stands generally present at 10 days after planting (Table 5). Gaucho and Temik significantly increased overall stands by an average of 17%, or approximately 5,800 plants/a. For Mycogen 1552 and NC+ 271, the increases were smaller and not statistically significant. On average, seedling vigor for all hybrids was improved somewhat by insecticides, and this was observed more clearly at 20 days than at 10 days after planting. An average of 1.3 chinch bugs/plant was present in early August. Insecticides slightly decreased the number of days from planting to half-bloom stage for Cargill 607E, DeKalb DK-56, Golden Harvest H-403, and Pioneer 8500 but not the remaining hybrids. Treatment had no effect on the number of heads/plant or on lodging percentage. Yield response to insecticide was generally positive but varied among hybrids. Significant yield increases of 13.7 to 28.0 bu/a occurred among four of seven hybrids. Test weight of grain from three hybrids increased slightly with insecticide.

Table 4. Effects of Gaucho and early planting on grain sorghum, Harvey County Experiment Field, Hesston, KS, 1997.

Sorghum Brand Hybrid	Insecticide[1]	Grain Yield	Test Wt	Plant Vigor	Plant Population May 16	Plant Population June 2	Half Bloom	Heads/ Plant
		bu/a	lb/bu	score[2]	1000's/a		days[3]	
Cargill 607E	None	90.4	58.7	3.6	21.1	24.9	85	1.7
Cargill 607E	Gaucho	98.4	58.2	3.6	28.0	31.5	85	1.6
DeKalb DK-56	None	69.3	60.2	3.4	10.8	12.4	93	2.0
DeKalb DK-56	Gaucho	99.3	60.3	2.4	20.1	22.5	91	1.6
Mycogen 1552	None	79.7	60.0	2.8	13.3	14.0	90	2.4
Mycogen 1552	Gaucho	86.4	60.2	2.5	12.9	14.0	89	2.6
NC+ 271	None	88.2	59.5	3.6	15.3	17.7	90	2.0
NC+ 271	Gaucho	107.9	59.8	2.8	20.8	23.1	90	1.8
Pioneer 8500	None	121.0	59.7	1.9	25.0	28.4	86	2.1
Pioneer 8500	Gaucho	122.0	59.8	1.9	38.0	40.4	84	1.6
LSD .05		10.3	0.55	0.85	3.1	2.5	1.1	0.27
Main effect means:								
Hybrid								
Cargill 607E		94.4	58.5	3.6	24.5	28.2	85	1.6
DeKalb DK-56		84.3	60.3	2.9	15.5	17.5	92	1.8
Mycogen 1552		83.0	60.1	2.6	13.1	14.0	89	2.5
NC+ 271		98.0	59.6	3.2	18.0	20.4	90	1.9
Pioneer 8500		121.5	59.7	1.9	31.5	34.4	85	1.8
LSD .05		7.3	0.39	0.60	2.2	1.8	0.8	0.19
Insecticide								
None		89.7	59.6	3.0	17.1	19.5	89	2.0
Gaucho		102.8	59.7	2.6	24.0	26.3	88	1.8
LSD .05		4.6	NS	0.38	1.4	1.1	0.5	0.12

[1] Seed treated with Gaucho 480 at 8 fl oz/cwt.
[2] Visual rating on May 16 on a scale of 1 to 5: 1 is best and 5 is poorest.
[3] Days from planting to half bloom.

Table 5. Effects of Gaucho and June planting on grain sorghum, Harvey County Experiment Field, Hesston, KS, 1997.

Sorghum Brand Hybrid	Insecticide[1]	Grain Yield	Test Wt	Plant Vigor	Plant Population July 7	Plant Population July 17	Half Bloom	Heads/ Plant
		bu/a	lb/bu	score[2]	1000's/a		days[3]	
Cargill 607E	None	83.6	55.7	2.8	36.8	36.7	60	1.1
Cargill 607E	Gaucho	94.2	55.5	1.2	43.1	43.4	58	1.1
DeKalb DK-56	None	95.8	57.8	3.0	32.8	33.3	67	1.1
DeKalb DK-56	Gaucho	123.8	58.9	1.5	39.5	39.7	65	1.0
Golden Harvest H-403	None	74.5	56.7	2.3	31.8	32.1	59	1.3
Golden Harvest H-403	Temik	91.2	58.1	1.1	42.5	42.2	58	1.2
Mycogen 1552	None	89.0	57.6	3.1	30.9	31.4	64	1.4
Mycogen 1552	Gaucho	110.3	58.4	1.8	32.3	32.5	63	1.5
NC+ 271	None	90.1	56.5	2.9	32.5	32.9	62	1.2
NC+ 271	Gaucho	87.1	56.8	1.9	36.1	36.3	61	1.1
N. King KS 555Y	None	79.5	56.9	3.3	30.3	30.2	61	1.2
N. King KS 555Y	Temik	93.2	57.4	1.9	38.5	38.3	61	1.1
Pioneer 8500	None	105.7	58.2	2.0	38.4	38.4	60	1.3
Pioneer 8500	Gaucho	116.8	58.6	1.4	43.0	43.2	58	1.2
LSD .05		11.6	0.74	0.65	4.5	4.7	0.8	0.18
Main effect means[4]:								
Hybrid								
Cargill 607E		88.9	55.6	2.0	39.9	40.0	59	1.1
DeKalb DK-56		109.8	58.4	2.3	36.1	36.5	66	1.1
Mycogen 1552		99.7	58.0	2.5	31.6	31.9	63	1.5
NC+ 271		88.6	56.6	2.4	34.3	34.6	61	1.1
Pioneer 8500		111.2	58.4	1.7	40.7	40.8	59	1.3
LSD .05		8.1	0.48	0.45	3.3	3.5	0.6	0.14
Insecticide								
None		92.8	57.1	2.8	34.3	34.5	62	1.2
Gaucho		106.4	57.6	1.5	38.8	39.0	61	1.2
LSD .05		5.1	0.30	0.28	2.1	2.2	0.4	NS

[1] Seed treated with Gaucho 480 at 8 fl oz/cwt. Temik 15 G applied in furrow at 7 lb/a.
[2] Visual rating on July 17 on a scale of 1 to 5: 1 is best and 5 is poorest.
[3] Days from planting to half bloom.
[4] Main effect means compared only for hybrids with and without Gaucho.

EFFECTS OF TERMINATION DATE OF HAIRY VETCH, WINTER, COVER CROP AND NITROGEN RATES ON GRAIN SORGHUM[1]

Mark M. Claassen

Introduction

Interest in the use of legume, winter, cover crops has been rekindled by concerns for soil and water conservation, dependency on commercial fertilizer, and maintenance of soil quality. Hairy vetch is a good candidate for the cover crop role, because it can be established in the fall when water use is reduced, it has winterhardiness, and it can fix substantial nitrogen (N). This experiment was conducted to investigate the effects of hairy vetch and N fertilizer rates on the supply of N to the succeeding grain sorghum crop as well as to assess sorghum yield response when the vetch is terminated at different time intervals before sorghum planting.

Procedures

The experiment was established on a Geary silt loam on which unfertilized winter wheat had been grown in 1995 and 1996. Reduced tillage practices with a disk and field cultivator were used to control weeds and prepare a seedbed. Hairy vetch was planted on September 13, 1996 at 15 lb/a in 8 in. rows with a grain drill equipped with double-disk openers.

Rainfall shortly after planting favored establishment of fall stands of hairy vetch. Precipitation during the entire vetch growing season was near to or slightly above normal. Volunteer wheat was controlled by a mid-March application of Fusilade + crop oil concentrate (2 oz ai/a + 1% v/v). One set of vetch plots was terminated early by disking on April 25 (DOT 1). Hairy vetch in a second set of plots was terminated in like manner on May 14 (DOT 2).

Vetch forage yield was determined by harvesting a 1 sq. meter area from each plot immediately before termination. Nitrogen fertilizer treatments were broadcast as ammonium nitrate on June 23, 1997. All plots received 35 lb/a of P_2O_5, which was banded as 0-46-0 at planting. Pioneer 8505 grain sorghum treated with Concep III safener and Gaucho insecticide was planted after rain delay at approximately 42,000 seeds/a on July 3, 1997. Weeds were controlled with a preemergence application of Microtech + atrazine (2.5 + 0.25 lb ai/a). Grain sorghum was combine harvested on November 6.

Results

Initial soil nitrate N (0 to 2 ft) and available P (0 to 6 in.) averaged 19 lb/a and 40 lb/a, respectively, and organic matter level was 2.1%. Hairy vetch provided excellent fall ground cover (63%) to decrease soil erosion (Table 6). At DOT 1, vetch was about 16 to 18 in. tall and had not reached bloom stage. A few plants were beginning to bloom at DOT 2. Average dry matter yields of hairy vetch were 2.66 tons/a at DOT 1 and nearly 3.0 tons/a at DOT 2. The average N contents were 2.76% and 3.15%, respectively. Consequently, the average potential amounts of N to be mineralized for use by the sorghum crop were 147 lb/a and 188 lb/a.

Disking to terminate hairy vetch growth did not adversely affect soil moisture at the surface because of ample spring rains, which ultimately delayed planting. Sorghum stands averaged 39,560 plants/a and were relatively uniform across treatments (Table 7). At low N rates, leaf N at boot to early heading stage was higher in sorghum after vetch than in sorghum without a prior vetch cover crop. Highest leaf N values occurred in sorghum following DOT 2 vetch. However, the effect of vetch termination date on leaf N was not always significant or consistent. The overall effect of N rate on leaf N was significant. A trend of increasing leaf N as N rate increased was consistent in sorghum without prior vetch. However, approximately 66 lb/a of N fertilizer was required to significantly increase leaf N in the absence of the cover crop. In sorghum following vetch, leaf N did not increase meaningfully above an N rate of 30 lb/a. At the zero N rate, vetch from DOT 1 and DOT 2 increased sorghum leaf N equivalent to that with 27 lb/a and 66 lb/a of fertilizer N. Sorghum following vetch required 1 to 2 days less time to reach half bloom than sorghum without a preceding cover crop. Averaged over N rates, sorghum yields were 6 to 10 bu/a more after vetch than where no cover crop had been grown. Highest yields were attained with an N rates of 90 lb/a in sorghum without prior vetch and 30 lb/a in sorghum following vetch. The positive effects of DOT 1 and DOT 2 vetch on the yield of sorghum without fertilizer N were equivalent to about 70 lb/a and 89 lb/a of N, respectively. A small, but significant, increase in the number of heads per plant accounted for most of the treatment effects on yield.

[1] This project was funded partially by a USDA (SARE) grant through the Kansas Rural Center.

Table 6. Initial soil test values, hairy vetch fall ground cover, and hairy vetch yield at spring termination, Harvey County Experiment Field, Hesston, KS, 1997.

Cover Crop/ Termination	N Rate[1]	Initial Soil NO_3-N[2]	Avail. Soil P	Soil Organic Matter	Fall Ground Cover[3]	Hairy Vetch[4] Yield	Hairy Vetch[4] N	Hairy Vetch[4] P
	lb/a	lb/a	lb/a	%	%	ton/a	lb/a	lb/a
None	0	19	39	1.9	--	--	--	--
	30	18	41	2.0	--	--	--	--
	60	19	39	2.1	--	--	--	--
	90	17	40	2.3	--	--	--	--
Vetch-April 25	0	20	37	2.0	59	2.75	145	13
	30	19	39	2.1	60	2.85	157	14
	60	22	42	2.1	62	2.45	148	12
	90	18	33	2.0	59	2.58	138	11
Vetch-May 14	0	18	54	2.1	66	3.11	215	20
	30	18	35	2.2	62	3.08	155	13
	60	17	45	2.1	71	3.28	210	20
	90	17	32	2.0	61	2.47	173	15
LSD .05		NS	NS	NS	NS	0.53	68	7
Means: Cover Crop/ Termination								
None		18	40	2.1	--	--	--	--
Vetch-April 25		20	38	2.1	60	2.66	147	12
Vetch-May 14		18	42	2.1	65	2.99	188	17
LSD .05		NS	NS	NS	NS	0.27	34	4
N Rate								
0		19	43	2.0	63	2.93	180	16
30		18	38	2.1	61	2.97	156	13
60		20	42	2.1	67	2.87	179	16
90		18	35	2.1	60	2.53	155	13
LSD .05		NS	NS	NS	NS	NS	NS	NS

[1] N applied as 34-0-0 June 23, 1997.

[2] Mean nitrate nitrogen (0 - 2 ft.), available P (0-6 in.) and organic matter (0-6 in.) on Sept. 11, 1996, 2 days before hairy vetch planting.

[3] Vetch cover estimated by 6 in. intersects on one 40 ft. line transect per plot on November 13, 1996.

[4] Oven dry weight as well as N and P contents determined just prior to respective vetch terminations.

Table 7. Effect of hairy vetch termination date and N rate on nutrient uptake, maturity, and yield of grain sorghum, Harvey County Experiment Field, Hesston, KS, 1997.

Cover Crop/ Termination	N Rate[1]	Stand	Leaf N[2]	Leaf P[2]	Half Bloom	Heads/ Plant	Grain Yield[4]	Mois
	lb/a	1000's/a	%	%	days[3]		bu/a	%
None	0 30	39.9	2.60	0.345	59	1.00	90.8	19.2
	60	39.5	2.62	0.363	60	1.03	97.3	19.2
	90	39.8	2.78	0.395	59	1.07	101.8	18.8
		39.3	2.91	0.407	59	1.18	107.0	18.4
Vetch-April 25	0	39.3	2.66	0.377	58	1.05	103.3	18.7
	30	39.3	2.85	0.394	58	1.13	108.3	18.4
	60	39.3	2.80	0.394	58	1.19	101.8	18.1
	90	38.7	2.86	0.392	59	1.13	105.4	18.4
Vetch-May 14	0	40.2	2.80	0.400	58	1.12	106.4	18.0
	30	39.7	2.93	0.408	57	1.15	110.5	18.0
	60	40.0	3.01	0.422	57	1.24	111.4	17.8
	90	39.7	2.60	0.395	58	1.15	107.0	18.1
LSD .05		NS	0.2	0.022	1.7	0.11	8.8	0.7
Means: Cover Crop/ Termination								
None		39.6	2.72	0.377	59	1.07	99.2	18.9
Vetch-April 25		39.2	2.79	0.389	58	1.13	104.7	18.4
Vetch-May 14		39.9	2.83	0.406	57	1.16	108.8	18.0
LSD .05		NS	NS	0.011	0.8	0.055	4.4	0.3
N Rate								
0		39.8	2.69	0.374	58	1.06	100.2	18.6
30		39.5	2.80	0.388	58	1.10	105.4	18.5
60		39.7	2.86	0.404	58	1.17	105.0	18.2
90		39.2	2.79	0.398	59	1.15	106.4	18.3
LSD .05		NS	0.12	0.013	NS	0.064	NS	NS

[1] N applied as 34-0-0 June 23, 1997.

[2] Leaf N and P at late boot to early heading stage. Leaf P adjusted for initial soil P.

[3] Days from planting to half bloom.

[4] Grain yield adjusted to 12.5% moisture and constant initial soil N and P.

EFFECTS OF HAIRY VETCH, WINTER, COVER CROP; TILLAGE; AND NITROGEN RATE ON GRAIN SORGHUM

Mark M. Claassen

Introduction

Hairy vetch can be utilized as a winter cover crop after wheat and prior to grain sorghum planted in the following spring. The amount of nitrogen (N) contributed by hairy vetch to grain sorghum in this cropping system remains under investigation. Termination of vetch by tillage prior to sorghum planting can cause significant loss of surface soil moisture. However, the use of herbicides to terminate the vetch may not allow adequate release of N from vetch in the absence of tillage. Effects of this experiment was conducted to evaluate effects of hairy vetch termination method and N rate on grain sorghum N uptake and yield.

Procedures

The experiment site was located on a Smolan silt loam on which a vetch-grain sorghum-winter wheat cropping system had been established initially in the fall of 1994. Wheat grown in 1996 had not been fertilized. In this second cycle, hairy vetch was no-till planted on September 13, 1996, into wheat stubble in which weeds and volunteer plants had been controlled with Roundup. A grain drill with double-disk openers on 7 in. spacing was used to seed the vetch at 15 lb/a. In the following spring, vetch forage yield was determined by harvesting 1 sq. meter areas in 12 representative plots just prior to vetch termination. Vetch was sprayed on May 15 at very early boom stage with Roundup + 2,4-D_{LVE} + Premier 90 nonionic surfactant (0.375 + 0.71 lb ae/a + 0.5%). Tillage plots were disked on May 17. Rains delayed N application and planting. Nitrogen fertilizer treatments were broadcast as ammonium nitrate on July 4. Pioneer 8500 grain sorghum treated with Concep II safener and Gaucho insecticide was planted at approximately 42,000 seeds/a on the same day. Weeds were controlled with a preemergence application of Microtech + atrazine (2.0 + 0.25 lb ai/a). Grain sorghum was combine harvested on November 7.

Results

Fall rains promoted vetch emergence and stand establishment. Seasonal precipitation for vetch was near to or slightly above normal. At the time of termination, vetch was 22 to 25 in. tall and had produced an average dry matter yield of about 2 tons/a with an average N content of 3.12% (Table 8). As a result, the potential amount of N to be mineralized for use by the sorghum crop averaged 128 lb/a. Sorghum stands averaged about 36,700 plants/a and were not affected by tillage or vetch treatments. Rainfall during the summer months was above normal. Sorghum following vetch reached half bloom 1 day earlier than sorghum after no cover crop. Also, half bloom was about 1 day earlier for no-till sorghum than for sorghum in tilled plots. Vetch significantly increased the N concentration of sorghum flag leaves at the zero N rate but not at 60 lb N/a. In sorghum following vetch, leaf N response to fertilizer was inconsistent at the 30 lb N/a rate but reached a maximum of 2.77 to 2.85% with 60 lb N/a. Tillage had no effect on leaf N level in sorghum. Grain yields increased by nearly 22 bu/a in unfertilized sorghum after vetch vs no vetch. This positive effect of vetch was equivalent to approximately 58 lb/a of N. The yield increase correlated with a slight increase in the number of heads per plant. Both vetch and N fertilizer slightly increased sorghum grain test weight.

Table 8. Effects of hairy vetch cover crop, tillage, and N rate on grain sorghum, Hesston, KS, 1997.

Cover Crop	Tillage System[1]	N Rate	Vetch Yield[2] Forage	Vetch Yield[2] N	Sorghum Stand	Leaf N	Half Bloom	Heads/ Plant	Grain Yield
			ton/a	lb/a	1000's/a	%[3]	days[4]		bu/a[5]
None	NT	0	----	---	37.8	2.26	61	1.03	73.3
		60	----	---	36.7	2.77	59	1.12	101.5
		90	----	---	37.6	2.78	57	1.14	102.9
	Disk	0	----	---	36.3	2.22	62	1.08	72.8
		60	----	---	36.5	2.77	60	1.20	95.0
		90	----	---	36.8	2.72	59	1.23	105.2
Hairy Vetch	NT	0	1.71	109	37.3	2.56	58	1.09	94.7
		30	2.10	129	36.1	2.57	58	1.22	105.1
		60	2.14	134	37.5	2.85	58	1.23	104.2
		90	2.21	137	36.7	2.63	58	1.26	110.0
	Disk								
		0	2.11	132	35.7	2.55	60	1.22	94.8
		30	2.10	131	36.5	2.72	59	1.20	99.2
		60	1.84	115	35.8	2.77	59	1.30	100.5
		90	2.17	135	36.4	2.76	59	1.26	97.6
LSD .05			NS	NS	NS	0.24	1.9	0.11	14.5
Main Effect Means:									
Cover Crop									
None			----	---	36.9	2.59	60	1.13	91.8
Hairy Vetch			2.05	128	36.6	2.69	59	1.23	100.3
LSD .05			----	---	NS	0.10	0.9	0.05	6.5
Tillage System									
No Till			2.04	127	37.3	2.64	59	1.15	97.7
Disk			2.05	128	36.2	2.63	60	1.21	94.3
LSD .05			NS	NS	0.9	NS	0.9	0.05	NS
N Rate									
0			1.91	121	36.8	2.40	60	1.11	83.9
30			2.10	130	----	----	--	----	-----
60			1.99	124	36.6	2.79	59	1.21	100.3
90			2.19	136	36.9	2.73	58	1.22	103.9
LSD .05			NS	NS	NS	0.13	1.1	0.06	8.0

[1] NT plots without vetch were tilled lightly at 10 and 7 weeks before planting.
[2] Oven dry weight and N content determined prior to application of specified N rates.
[3] Flag leaf N content at late boot to early heading.
[4] Days from planting to 50% bloom.
[5] Mean yields from three replications adjusted to standard 12.5% moisture.

GRASS HERBICIDE EFFECTS ON EARLY-PLANTED GRAIN SORGHUM

Mark M. Claassen and David L. Regehr

Introduction

In prior research at Hesston, early-planted (May) grain sorghum outperformed that planted at the conventional time (June) in years with favorable seasonal weather patterns. In those experiments, unsafened sorghum seed was planted, and Ramrod (propachlor) was applied for preemergence grass control. Stronger grass herbicides such as Dual and Lasso, which require safened seed, were avoided here to minimize the possibilty of injury under the str conditions of cool soil temperatures. Over time, grass control became a greater concern in early-planted sorghum because of slower development of plant canopy and late emergence of weeds. This experiment was conducted to assess the effect of five grass herbicides applied at normal and double rates on eight early-planted sorghum hybrids.

Procedures

Sorghums were selected for this study on the basis of genetic diversity, general use by growers, previous investigations on cold tolerance, and endosperm color. Soybeans were grown on the site in 1996. The area was fertilized with 90 lb N/a and 32 lb P_2O_5/a broadcast and incorporated in late March. The seedbed was prepared with a field cultivator and mulch treader. Sorghum seed treated with Concep III safener and Gaucho insecticide was planted about 1.25 in. deep at three seeds/ft of 30 in. row on April 23, 1997. Immediately after planting, all herbicides treatments were applied in 20 gal/a of water with XR8003 flat-fan nozzles. Injury ratings and stand counts were taken at 19 and 40 days after planting. Plots were harvested on September 11 and 12.

Results

Soil physical condition at planting was excellent but somewhat dry in the seed zone. Soil temperatures at seed depth stayed cool after planting until May 3. During this time, the soil reached or exceeded 70 °F for a total of only 7.4 hours. From May 3 through May 12, soil temperatures averaged 59 to 68 °F and reached or exceeded 70 °F for an average of 6.9 hours per day. Light rains fell at 2 and 7 days after planting followed by 0.31 in. and 0.64 in. at 8 and 14 days after planting, respectively. Sorghum emergence began about May 5 and reached 97% of the final average stand 7 days later.

Injury ratings were made on the basis of color as well as size and uniformity of plants. Consequently, these ratings reflected the combination of soil temperature and herbicide effects. On May 12, injury ratings averaged 5%, with no indication of differences among herbicide treatments or of interactions between hybrids and herbicides. Significant differences were observed among hybrids, with Mycogen 1506, NC+ 6B50, and Pioneer 8500 showing the most vigor or least injury (Table 9). Two hybrids with yellow endosperm, DeKalb 40-y and Pioneer 8699, as well as DeKalb DK-35 had the highest injury scores of 8 to 12%. On June 2, the average injury rating was 4%, and herbicide effects again were insignificant. However, some hybrids improved, and changes in their relative ranking occurred. Northrup King KS 710 appeared to be comparable in rating with those that were best in mid-May. DeKalb DK-35 and Pioneer 8699 improved, whereas DK-40y showed a significantly higher injury rating.

Sorghum populations on May 12 averaged 32,800 plants/a or 63% of the planting rate. Final populations on June 2 only increased to 34,100 plants/a, i.e, 65% of the number of seed planted. Herbicide treatments did not significantly affect sorghum stands. Hybrids differed considerably in population. Pioneer 8500 had the highest and DK-40y had the lowest stand percentages.

Herbicide treatments had no significant effects on the number of days from planting to half bloom, plant height, yield, or bushel weight of grain produced (Table 10). Hybrid effects on each of these variables were significant, but no meaningful interactions occurred between treatments and hybrids. DeKalb DK-40y and Mycogen 1482 had the lowest yields, averaging 96 bu/a. The mean yield for the remaining hybrids was 107 bu/a. Notably, DeKalb DK-35 and Pioneer 8699 recovered from the highest initial injury scores to produce yields not differing significantly from those of hybrids with the least initial injury.

Table 9. Effects of grass herbicides and hybrids on injury, stand, and plant height of early-planted grain sorghum, Harvey County Experiment Field Hesston, KS, 1997.

Herbicide Treatment[1]	Rate lb ai/a	Sorghum Brand Hybrid	Injury 5/12	Injury 6/2	Stand 5/12	Stand 6/2	Plant Height
Main effect means:			%		%		in.
1 Dual II Magnum + Atraz	1.25 + 1.0		5	4	61	64	48
2 Dual II Magnum + Atraz	2.5 + 1.0		4	5	64	67	49
3 Partner + Atraz	2.5 + 1.0		5	4	65	67	49
4 Partner + Atraz	5.0 + 1.0		5	4	63	65	48
5 Ramrod + Atraz	4.0 + 1.0		5	4	65	67	49
6 Ramrod + Atraz	8.0 + 1.0		5	4	63	65	49
7 Frontier + Atraz	1.25 + 1.0		5	4	62	64	49
8 Frontier + Atraz	2.5 + 1.0		5	5	62	65	49
9 Harness CR + Atraz	1.8 + 1.0		6	4	61	64	49
10 Harness CR + Atraz	3.6 + 1.0		5	4	61	64	49
11 Atrazine	1.0		4	5	63	66	48
LSD .05			NS	NS	NS	NS	NS
		DeKalb DK-35	11	4	59	63	46
		Dekalb DK-40y	8	14	45	49	47
		Mycogen 1482	4	5	61	63	45
		Mycogen 1506	1	0	62	64	58
		NC+ 6B50	0	1	62	63	48
		N.King KS 710	3	1	61	63	45
		Pioneer 8699	12	7	73	77	49
		Pioneer 8500	0	2	79	80	51
		LSD .05	0.9	0.9	2.7	2.4	0.4

[1] **Note: Harness and Harness CR are not currently labeled for grain sorghum.**
Formulations: AAtrex 90 DF, Dual II Magnum 7.64 EC, Frontier 6.0 EC, Harness CR 3.8 L, Partner 65 DF, and Ramrod 4 L.

Table 10. Effects of grass herbicides and hybrids on maturity and yield of early-planted grain sorghum, Harvey County Experiment Field, Hesston, KS, 1997.

Herbicide Treatment[1]	Rate lb ai/a	Sorghum Brand Hybrid	Yield	Bu Wt	Half Bloom	Heads/ Plant
			bu/a	lb	days	
Main effect means:						
1 Dual II Magnum + Atraz	1.25 + 1.0		106	59.4	85	1.7
2 Dual II Magnum + Atraz	2.5 + 1.0		104	59.4	85	1.6
3 Partner + Atraz	2.5 + 1.0		98	59.6	85	1.6
4 Partner + Atraz	5.0 + 1.0		108	59.6	85	1.7
5 Ramrod + Atraz	4.0 + 1.0		103	59.6	84	1.7
6 Ramrod + Atraz	8.0 + 1.0		106	59.4	85	1.7
7 Frontier + Atraz	1.25 + 1.0		107	59.7	85	1.7
8 Frontier + Atraz	2.5 + 1.0		98	58.9	85	1.7
9 Harness CR + Atraz	1.8 + 1.0		107	59.8	85	1.7
10 Harness CR + Atraz	3.6 + 1.0		106	59.6	85	1.7
11 Atrazine	1.0		107	59.4	85	1.7
LSD .05			NS	NS	NS	NS
		DeKalb DK-35	107	59.5	81	1.8
		DeKalb DK-40y	95	59.8	87	1.8
		Mycogen 1482	96	58.9	85	1.5
		Mycogen 1506	105	59.4	87	1.6
		NC+ 6B50	110	58.5	86	1.5
		N.King KS 710	107	59.6	86	1.8
		Pioneer 8699	108	60.2	81	1.7
		Pioneer 8500	108	59.9	83	1.7
		LSD .05	5.4	0.20	0.2	0.07

[1] **Note: Harness and Harness CR are not currently labeled for grain sorghum.**
Formulations: AAtrex 90 DF, Dual II Magnum 7.64 EC, Frontier 6.0 EC, Harness CR 3.8 L, Partner 65 DF, and Ramrod 4 L.

HERBICIDES FOR WEED CONTROL IN SOYBEANS

Mark M. Claassen

Introduction

Successful soybean production is dependent upon effective weed control. Growers can choose from a number of herbicide options to accomplish this objective. In recent years the number of herbicides available for weed control in soybeans has increased notably. This experiment was conducted to evaluate new herbicides and herbicide combinations for weed control efficacy as well as soybean tolerance.

Procedures

The experiment site was located near Sedgwick, KS, on a Naron fine sandy loam. Soybeans were grown on the area in 1996. Asgrow 3601 Roundup Ready + STS soybeans were planted at 140,000 seeds/a in 30 in. rows on May 12, 1997. Seedbed condition was excellent. All herbicide treatments other than Roundup were broadcast in 20 gal/a of water, with three replications per treatment. These were applied with XR8003 flat-fan nozzles at 20 psi (preemergence) or 30 psi (postemergence). Roundup and Roundup tank mixes were applied in 10 gal/a of water with XR80015 flat fan nozzles at 30 psi. Preemergence applications were made on May 14. Postemergence treatments 11 through 29 were applied on June 8. Soybeans were then 4 to 6 in. tall with one to two trifoliolate leaves; Palmer amaranth was mostly 1 to 4 in. tall, with some scattered larger plants; a few ivyleaf morningglory were 4 to 5 in. tall; and large crabgrass was less than 3 in. tall. Postemergent herbicides in treatments 4 through 10 as well as in treatments 14 (Roundup Post 2) and 17 (Roundup Post 2) were applied on June 26 when soybeans were 13 to 17 in. tall with five to six trifoliolate leaves. Considerable dew was present when Roundup in these treatments was applied. Large crabgrass at that time was 1 to 6 in. tall, and ivyleaf morningglory was 1 to 4 in. tall. Palmer amaranth height varied from 3 to 19 in., but numerous plants were 15 in. tall in plots receiving treatments 14 and 17. Crop injury and weed control were rated at various times during the growing season. Soybeans yields were not measured.

Results

Authority + Classic applied at 3.71 + 0.74 oz ai/a caused early, minor soybean stunting which was temporary. Prowl resulted in some stunting, as well as leaf necrosis. Action caused necrotic spots on soybean leaves. Treatments involving Cobra caused the greatest crop injury in terms of leaf necrosis.

All Canopy and Authority + Classic treatments in combination with a grass herbicide or Roundup gave excellent control of all weed species present. Roundup + Classic also resulted in good to excellent weed control, but the higher rate of Classic (0.833 oz ai/a) in this combination tended to be superior to the lower rate (0.063) at the final rating. Synchrony STS + Cobra + Assure II provided good, but somewhat less effective, weed control. Notably, this tank mix without Cobra resulted in little control of Palmer amaranth, necessitating a follow-up Roundup application. Roundup at 8 oz ai/a was least effective on ivyleaf morningglory and eastern black nightshade. A higher rate of 16 oz ai/a significantly improved the control of these two species. Sequential applications of Roundup at 8 oz ai/a were superior to a single application of 16 oz ai/a for Palmer amaranth control and tended to give better control of other species as well. Action alone following Dual II preemergence gave good control of

Palmer amaranth, excellent control of eastern black nightshade, but inferior control of ivyleaf morningglory. Action + Expert and Expert + Cobra as well as Expert + Roundup satisfactorily controlled all species. Pursuit alone or in combination with Pinnacle following preemergence Prowl did not control Palmer amaranth effectively but performed well on the other species. However, Pursuit in combination with Cobra provided good control of Palmer amaranth.

Soybean yields were not measured.

Table 11. Weed control in soybeans, Sedgwick, KS, 1997.

Herbicide Treatment[1]	Rate oz ai/a	Timing[2]	Inj. 6/14	Weed Control[3] Paam 7/22	Ilmg 7/22	Ebns 7/22	Lacg 7/22
			%	%	%	%	%
1 Canopy + Dual II	3.0 + 31.2	Pre	0	92	95	96	98
2 Canopy + Dual II	4.5 + 31.2	Pre	1	91	93	96	99
3 Authority + Classic + Dual	2.25+ 0.45+ 23.4	Pre	0	98	97	100	89
4 Authority + Classic Assure II + COC	1.69 + 0.34 0.88 + 1%	Pre Post	0	92	98	99	100
5 Authority + Classic Assure II + COC	2.25 + 0.45 0.88 + 1%	Pre Post	0	99	99	100	99
6 Authority + Classic Assure II + COC	3.19 + 0.64 0.88 + 1%	Pre Post	0	99	99	99	99
7 Authority + Classic Assure II + COC	3.71 + 0.74 0.88 + 1%	Pre Post	0	100	97	100	99
8 Authority + Classic Synchrony STS + Assure II + COC + UAN	1.69 + 0.34 0.21 + .88 + 0.5% + 2qt	Pre Post	0	98	97	100	98
9 Authority + Classic Roundup Ultra	1.69 + 0.34 8.0	Pre Post	0	96	99	99	94
10 Authority + Classic Roundup Ultra + Classic + NIS + UAN	1.69 + 0.34 8.0 + 0.063 + 0.25% + 2 qt	Pre Post	0	99	99	100	99
11 Roundup Ultra + Classic + NIS + UAN	8.0 + 0.063 + 0.25% + 2 qt	Post	0	88	90	82	82
12 Roundup Ultra + Classic + + NIS + UAN	8.0 + 0.833 + 0.25% + 2 qt	Post	0	94	96	96	94
13 Synchrony STS + Cobra + Assure II + COC + UAN	0.21 + 1.0 + 0.88+ 1% + 2 qt	Post	17	82	87	83	88
14 Synchrony STS + Assure II + COC + UAN Roundup Ultra	0.21 + 0.88 + 1% + 2 qt 16.0	 Post Post 2	 0	76	93	88	97
15 Synchrony STS + Roundup Ultra + NIS + UAN	0.21 + 8.0 + 0.25% + 2 qt	Post	0	88	98	95	90
16 Roundup Ultra	8	Post	0	86	74	79	91
17 Roundup Ultra Roundup Ultra	8.0 8.0	Post Post 2	0	99	90	100	98

(Continued)

Table 11. Weed control in soybeans, Sedgwick, KS, 1997.

Herbicide Treatment[1]	Rate oz ai/a	Timing[2]	Inj. 6/14	Weed Control[3] Paam 7/22	Ilmg 7/22	Ebns 7/22	Lacg 7/22
			%	%	%	%	%
18 Roundup Ultra	16	Post	0	87	88	93	84
19 Dual II	24	Pre					
Action + COC	0.057 + 1 qt	Post	13	87	74	95	88
20 Dual II	24	Pre					
Action + COC	0.071 + 1 qt	Post	12	89	72	98	86
21 Dual II	24	Pre					
Action + Expert + COC	.057+ 1.128+ 1 qt	Post	10	87	87	96	96
22 Dual II	24	Pre					
Action + Expert + COC + UAN	0.057 + 1.128 + 1 pt + 2 qt	Post	11	84	88	95	92
23 Dual II	24	Pre					
Expert + Cobra + COC + UAN	1.128 + 1.5 + 1 pt + 1 pt	Post	20	86	86	99	91
24 Prowl	16.5	Pre					
Pursuit + COC + UAN	1.0 + 1 qt + 2 qt	Post	12	65	89	100	98
25 Prowl	16.5	Pre					
Pursuit + Pinnacle + COC + UAN	1.0 + 0.047 + 1 qt + 2 qt	Post	13	70	87	100	97
26 Prowl	16.5	Pre					
Pursuit + Cobra + COC + UAN	1.0 + 1.5 + 1 pt + 2 qt	Post	21	87	88	99	96
27 Roundup Ultra	11.94	Post	0	83	82	93	85
28 Expert + Roundup Ultra + NIS	1.128 + 5.98 + 0.25%	Post	0	92	90	91	96
29 Expert + Roundup Ultra + NIS + AMS	1.128 + 5.98 0.25% + 2.5	Post	0	88	89	86	94
30 No Treatment			0	0	0	0	0
LSD .05			2	10	7	8	9

[1] This project was supported partially by American Cyanamid, Du Pont, and Novartis.
Note: Action and Expert currently are not labeled for use in soybeans.
Herbicide formulations: Action 4.75 WP, Assure II 0.88 EC, Authority 75 DF, Canopy 75 DF, Classic 25 DF, Cobra 2 SC, Dual II 7.8 EC, Expert 75 WG, Pinnacle 25 DF, Prowl 3.3 EC, Pursuit 70 DG, Roundup Ultra 4 SC, Synchrony STS 42 DF. COC = Farmland Crop Oil Plus. NIS = Pen-A-Trate II nonionic surfactant.
UAN = 28% urea ammonium nitrate fertilizer.
[2] Pre = preemergence. Post = postemergence. Post 2 = sequential postemergence application 18 days after initial treatment.
[3] Paam = Palmer amaranth. Ilmg = ivyleaf morningglory. Ebns = eastern black nightshade. Lacg = large crabgrass.

WEED CONTROL IN SOLID-SEEDED VERSUS ROW-PLANTED ROUNDUP READY SOYBEANS

Mark M. Claassen and Phillip W. Stahlman

Introduction

Roundup has been used widely for nonselective weed control in fallow periods between crops and in no-till production prior to crop emergence. The development of Roundup-resistant soybeans allows use of this herbicide for broad-spectrum, postemergence, weed control during the growing season. Questions remain concerning the optimum rate and time of Roundup application, as well as the impact of row spacing on weed control efficacy. This study focused on these issues, the use of a preemergent herbicide before Roundup postemergence, and the relative effectiveness of the Roundup program versus a total preemergence weed control program or standard postemergence treatments.

Procedures

The experiment site was cropped to oats in 1996. The soil was a Smolan silt loam with pH 7.1 and 2.7% organic matter. Pigweed and large crabgrass seed were broadcast prior to the last preplant tillage operation to promote uniformity of weed populations. Asgrow 3601 RR + STS and Asgrow 3704 STS soybeans were planted in 8-inch and 30-inch rows at 140,000 seeds/a on June 7, 1997. Seedbed condition was excellent.

Preemergence applications were made in 20 gal/a of water with XR8003 nozzles at 18 psi on June 8. Postemergence treatments were applied in 10 gal/a of water with XR80015 flat fan nozzles at 30 psi. The timing of postemergence treatments was as follows: early postemergence (EP) to 0.5 to 3 in. pigweeds on June 27; postemergence (P) to 4 to 6 in. pigweeds and 3 to 5 in. large crabgrass on July 4; and sequential (Seq) Roundup including EP followed by a later postemergence application at the same initial rate to 4 to 9 in. pigweeds and 2 to 8 in. crabgrass on July 26. All treatments were replicated four times. Crop injury and weed control were rated at various times during the growing season. Soybeans were harvested on October 20 and 21, 1997.

Results

Rainfall totalled 2.10 inches in the first week after planting. Above-normal rainfall occurred throughout the season. Soybean populations varied from 95,600 to 123,500 plants/a in 8 in. rows but consistently averaged 137,700 plants/a in 30 in. rows. Dense populations of pigweed (primarily redroot with a smaller, less consistent percentage of Palmer amaranth) and large crabgrass developed. In late June, densities of 84 pigweeds/ft^2 and 88 large crabgrass plants/ft^2 were common across the site. However, pigweed populations in untreated check plots varied somewhat. There were relatively few late germinating weeds.

Pigweed control was affected significantly by Roundup rate, time of application, and rate by time interaction (Table 12). EP Roundup application provided excellent pigweed control, regardless of rate, but delayed application resulted in somewhat less control at the 1 pt/a rate than at higher rates. Preemergence Prowl had reduced pigweed populations nearly 70% by the normal EP timing. Consequently, reduction in early weed competition could have allowed for a wider acceptable window for subsequent Roundup application or possibly reduced the optimum amount of Roundup required. However, under the existing conditions, preemergence Prowl plus Roundup EP versus Roundup EP alone did not enhance final pigweed control or soybean production. Squadron, Prowl followed by Pursuit postemergence, and Raptor alone postemergence also controlled pigweeds effectively. However, Raptor brought pigweeds under control more slowly, as evidenced by the early evaluations. Row spacing did not affect pigweed control with any of the herbicide treatments.

Roundup rate, time of application, rate by time interaction, and time by row spacing interaction significantly affected large crabgrass control (Table 13). Roundup rates of 1.5 or 2.0 pt/a were superior to the 1.0 pt/a rate, particularly when larger weeds were treated, as a result of delayed application. Narrow rows enhanced large crabgrass control with Roundup applied EP but not when applied later or sequentially. Preemergence Prowl had reduced large crabgrass populations approximately 90% by the time of EP Roundup application. Prowl in combination with Roundup EP at 1 pt/a enhanced season-long control of large crabgrass in comparison with Roundup EP alone in 30 in. soybean rows but not in 8 in. rows at this rate or in either row spacing at 1.5 pt/a. Squadron preemergence controlled large crabgrass effectively in both row spacings, but slightly better control occurred in narrow rows. Prowl preemergence plus Pursuit postemergence also controlled large crabgrass effectively without any soybean row spacing effect. Raptor alone postemergence resulted in inferior large crabgrass control.

Slight soybean injury from Prowl was observed in some narrow-row plots. However, no apparent injury of consequence occurred from any of the herbicides. All herbicide treatments except Roundup EP at 1.0 pt/a in 30 in. rows significantly increased soybean yield over that of the untreated check. The average yield response from herbicides was 24 bu/a. Among treatments with Roundup alone, the only significant main effect was that of row spacing, with 8 in. rows producing 7.5 bu/a more than 30 in. rows. The use of Prowl preemergence in combination with Roundup postemergence did not enhance yield over that obtained with Roundup alone. Notably, among all treatments involving a preemergence herbicide, the row spacing effect was not significant. The comparison of all Roundup treatments versus non-Roundup treatments showed no significant yield difference. Similarly, Roundup Ready and non-Roundup Ready soybeans produced comparable average yields of 49.7 and 51.7 bu/a, respectively, without any significant difference.

This project was funded partially by the Kansas Soybean Commission.

Table 12. Effects of herbicides and row spacings on weeds and soybean, Hesston, KS, 1997.

Herbicide Treatment/Row Spacing/Variety[1]	Rate/a Product	Timing[2]	Injury 7/10	Weed Control[3] Rrpw 8/1	Lacg 8/1	Yield
			%	%	%	bu/a
3 Roundup Ultra 8 in. RR	1.0 pt	P	0	86	78	43
4 Roundup Ultra 30 in. RR	1.0 pt	P	0	86	79	48
5 Roundup Ultra 8 in. RR	1.0 pt	Seq	1			59
Roundup Ultra	1.0 pt			100	100	
6 Roundup Ultra 30 in. RR	1.0 pt	Seq	0			48
Roundup Ultra	1.0 pt			100	100	
7 Roundup Ultra 8 in. RR	1.5 pt	EP	0	100	98	51
8 Roundup Ultra 30 in. RR	1.5 pt	EP	0	99	95	45
9 Roundup Ultra 8 in. RR	1.5 pt	P	0	92	91	56
10 Roundup Ultra 30 in. RR	1.5 pt	P	0	95	90	47
11 Roundup Ultra 8 in. RR	1.5 pt	Seq	0			56
Roundup Ultra	1.5 pt			100	99	
12 Roundup Ultra 30 in. RR	1.5 pt	Seq	0			46
Roundup Ultra	1.5 pt			100	100	
13 Roundup Ultra 8 in. RR	2.0 pt	EP	0	99	97	57
14 Roundup Ultra 30 in. RR	2.0 pt	EP	0	98	93	49
15 Roundup Ultra 8 in. RR	2.0 pt	P	0	96	96	51
16 Roundup Ultra 30 in. RR	2.0 pt	P	0	92	97	50
17 Roundup Ultra 8 in. RR	2.0 pt	Seq	0			53
Roundup Ultra	2.0 pt			100	100	
18 Roundup Ultra 30 in. RR	2.0 pt	Seq	0			47
Roundup Ultra	2.0 pt			100	100	
19 Prowl 8 in. RR	2.5 pt	Pre	2			
Roundup Ultra	1.0 pt	EP		98	94	45
20 Prowl 30 in. RR	2.5 pt	Pre	0			
Roundup Ultra	1.0 pt	EP		99	96	47
21 Prowl 8 in. RR	2.5 pt	Pre	1			
Roundup Ultra	1.5 pt	EP		98	97	51
22 Prowl 30 in. RR	2.5 pt	Pre	0			
Roundup Ultra	1.5 pt	EP		99	97	52
23 Squadron 8 in. RR	3.0 pt	Pre	1	100	98	52
24 Squadron 30 in. RR	3.0 pt	Pre	0	100	92	44

(Continued)

Table 12. Effects of herbicides and row spacings on weeds and soybean, Hesston, KS, 1997.

Herbicide Treatment/Row Spacing/Variety[1]		Rate/a Product	Timing[2]	Injury 7/10	Weed Control[3] Rrpw 8/1	Lacg 8/1	Yield
				%	%	%	bu/a
25 Squadron	8 in. N	3.0 pt	Pre	0	100	99	49
26 Squadron	30 in. N	3.0 pt	Pre	0	100	94	55
27 Prowl	8 in. N	2.5 pt	Pre				
Pursuit + Sun-It II + UAN		1.4 oz + 1 qt + 1 qt	P	2	100	92	56
28 Prowl	30 in. N	2.5 pt	Pre				
Pursuit + Sun-It II + UAN		1.4 oz + 1 qt + 1 qt	P	0	100	96	51
29 Raptor + Sun-It II + UAN		2.5 pt	Pre				
	30 in. N	5.0 oz + 1.5 pt + 1 qt	P	0	98	78	46
30 Untreated	8 in. N			0	0	0	28
31 Untreated	30 in. N			0	0	0	24
LSD .05				1	2	5	14

[1] Herbicide formulations: Prowl 3.3 EC, Pursuit 70 DG, Raptor 1 L, Roundup Ultra 4 SC, Squadron 2.33 EC.
UAN = 28% urea ammonium nitrate fertilizer.
RR = Asgrow AG 3601 Roundup Ready + STS soybeans. N = Asgrow A3704 STS soybeans.
[2] Pre = preemergence to soybeans and weeds on June 8.
EP = early postemergence to 0.5 to 3in. weeds on June 27; P = postemergence to 4 to 6 in. weeds on July 4;
Seq = two sequential applications of base herbicide rate: EP followed by later postemergence treatment (4 to 9 in. weeds) on July 26.
[3] Rrpw = redroot pigweed. August 1 column contains ratings on July 25 (no change) for all treatments not receiving the second sequential application.

Table 13. Effects of roundup and row spacings on weeds and soybeans, Hesston, KS, 1997.

Treatment Means[1]	Rate/a Product	Timing	Row Spacing	Injury 7/10	Weed Control Rrpw 8/1	Weed Control Lacg 8/1	Yield
			in.	%	%	%	bu/a
Rate	1.0 pt			0	95	89	49
	1.5 pt			0	97	95	50
	2.0 pt			0	98	97	51
	LSD .05			NS	1	2	NS
Timing		EP		0	99	93	50
		P		0	91	88	49
		Seq		0	100	100	51
		LSD .05		NS	1	2	NS
Row Spacing			8 in.	0	97	95	54
			30 in.	0	96	93	46
			LSD .05	NS	NS	NS	5
Rate x Timing	1.0 pt	EP		0	99	89	48
		P		0	86	79	46
		Seq		0	100	100	53
	1.5 pt	EP		0	99	96	48
		P		0	93	91	52
		Seq		0	100	100	51
	2.0 pt	EP		0	99	95	53
		P		0	94	96	51
		Seq		0	100	100	50
	LSD .05			NS	2	3	NS
Rate x Row Spacing	1.0 pt		8	0	90	90	53
			30	0	88	88	44
	1.5 pt		8	0	96	96	54
			30	0	95	95	46
	2.0 pt		8	0	97	97	54
			30	0	97	97	49
	LSD .05			NS	NS	NS	NS
Timing x Row Spacing		EP	8	0	99	96	55
			30	0	99	91	44
		P	8	0	91	88	50
			30	0	91	89	48
		Seq	8	0	100	100	56
			30	0	100	100	47
		LSD .05		NS	NS	3	NS

[1] See footnotes in Table 12.

SPRING OAT VARIETIES

Mark M. Claassen and Kraig L. Roozeboom

Introduction

Spring oats can serve a useful roll as a rotational crop when weather or soil conditions prevent implementation of a particular crop sequence. They also can provide a significant grain or forage resource in a diversified crop-livestock operation. Performance tests with oats were conducted here to evaluate yield potential and other agronomic characteristics of varieties currently available.

Procedures

Spring oats were seeded on February 23, 1997 at 64 lb/a on a site cropped to soybeans in 1996. Fertilizer (89 lb/a of N and 35 lb/a of P_2O_5) was broadcast and incorporated before planting. No herbicide was used. Plots were harvested on July 18.

Results

The seedbed was moist at planting. Oats emerged on March 24 to 26 and survived temperatures in the low 20s during April 11 to 13. Spring rains and subsequent mild temperatures favored oat development.
A minor problem with barley yellow dwarf disease appeared late but had limited effect. Major lodging occurred as grain was maturing. Shattering was minor, and no ratings were taken. Despite the severe lodging, oat grain yields were relatively high.

Table 14. Performance of spring oat varieties, Harvey County Experiment Field, Hesston, KS, 1997.

Variety	Origin	Yield[1] 1997	1996	1995	1994	Test Wt.	Maturity[2]	Plant Ht.	Lodging
		bu/a				lb/bu	days	in.	%
Armor	Ohio	83	89	26	58	33	6	45	90
Bates	KS FDN	67	86	36	73*	35	0	42	98
Bay	Wisconsin	82	64	--	--	31	10	42	92
Belle	Wisconsin	44	61	--	--	34	10	43	94
Brawn	Illinois	75	114*	49*	54	34	4	39	100
Chairman	Ohio	82	--	--	--	33	0	43	95
Dane	Wisconsin	72	64	41	58	35	-2	41	81
Don	KS FDN	66	92	42	71*	35	0	41	100
Gem	Wisconsin	83	85	--	--	34	8	46	97
Hazel	Illinois	63	82	31	55	34	2	38	100
Horicon	Wisconsin	80	76	27	56	34	3	44	96
IL862081	Illinois	98*	--	--	--	33	3	43	90

(Continuned)

Table 14. Performance of spring oat varieties, Harvey County Experiment Field, Hesston, KS, 1997.

		Yield[1]							
Variety	Origin	1997	1996	1995	1994	Test Wt.	Maturity[2]	Plant Ht.	Lodging
		bu/a				lb/bu	days	in.	%
IL891730	Illinois	79	--	--	--	35	4	43	100
IN09201	Indiana	84	--	--	--	34	-1	38	99
Jerry	N. Dakota	76	--	--	--	36	4	47	85
Jim	Minnesota	85	--	--	--	34	0	42	93
Larry	KS FDN	57	75	18	74*	34	-2	38	99
Milton	Minnesota	91*	--	--	--	33	8	43	95
Ogle	KS FDN	87	77	42	65	33	2	42	100
Prairie	Wisconsin	74	91	33	58	31	8	42	100
Premier	Minnesota	81	89	24	62	36	3	42	99
Rio Grande	Colorado	76	--	--	--	30	10	40	99
Rodeo	Illinois	88	--	--	--	33	5	43	94
Russel	Canada	62	--	--	--	32	10	50	58
Settler	S. Dakota	74	--	--	--	33	4	45	98
Troy	S. Dakota	78	--	--	--	31	11	49	92
Average		76	82	32	62	33	4	43	94
LSD .05		8.8	6	3	4	0.9	0.6	1.6	5

1 Average of four replications adjusted to 12% moisture. * = upper LSD group.

2 Days earlier or later than Bates, which reached 50% heading on May 26.

IRRIGATION AND NORTH CENTRAL KANSAS EXPERIMENT FIELDS

Introduction

The 1952 Kansas legislature provided a special appropriation to establish the Irrigation Experiment Field in order to serve the expanding irrigation development in north-central Kansas. The original 35-acre field was located 9 miles northwest of Concordia. In 1958, the field was relocated to its present site on a 160-acre tract near Scandia in Kansas Bostwick Irrigation District. Water is supplied by the Miller Canal and is stored in Lovewell Reservoir in Jewell County and Harlen County Reservoir at Republican City, Nebraska. A 5-acre site in the Republican River valley on the Mike Brazon Farm also is utilized for research on irrigated crops. In 1997, there were approximately 125,000 acres of irrigated cropland in north central Kansas. Current research at the field focuses on managing water and fertilizer in reduced-tillage systems and crop rotations.

The 40-acre North Central Kansas Experiment Field, located 2 miles west of Belleville, was established on its present site in 1942. The field provides information on factors that allow full development and wise use of natural resources in north central Kansas. Current research emphasis is on fertilizer management of reduced-tillage production systems for wheat, soybeans, grain sorghum, and corn.

Soil Description

The predominate soil on both fields is a Crete silt loam. The Crete series consists of deep, well drained soils that have a loamy surface underlain by a clayey subsoil. These soils developed in loess on nearly level to gently undulating uplands. The Crete soils have slow to medium runoff and slow internal drainage and permeability. Natural fertility is high. Available water holding capacity is approximately 0.19 inch of water per inch of soil.

1997 Weather Information

The 1997 growing season was characterized by below-normal rainfall throughout the growing season. Growing season rainfall was 8 inches below normal. Temperatures were much below normal in April and May. Cool-dry conditions limited early-season plant growth. Temperatures in July and August were slightly below normal. Temperature in September was much above normal.

Table1. Climate data for the North-Central Kansas Experiment Fields, Scandia and Belleville, KS, 1997.

	Rainfall, inches			Temperature, °F		Growth Units	
Month	Scandia 1997	30-Year Avg.	Belleville 1997	Daily Mean	Avg. Mean	1997	Normal
April	2	2.4	3.9	46	53	173	242
May	1.2	3.7	1.0	59	64	360	427
June	2.2	4.8	2.4	74	74	691	718
July	2.1	3.3	2.6	78	79	800	835
August	2.9	3.3	2.1	75	77	703	748
Sept.	1.9	3.5	1.9	70	67	564	518
Total	12.3	20.9	13.9			3290	3487

EVALUATION OF AMISORB FOR CORN AND GRAIN SORGHUM

W. Barney Gordon

Summary

Amisorb applied at 2 qt/a with starter fertilizer (30 lb N and 30 lb P_2O_5/a) applied 2 inches to the side and 2 inches below the seed at planting increased grain yield of irrigated corn compared to starter alone or starter plus ACA or Asset. Amisorb did not affect growth, nutrient uptake, or yield of dryland grain sorghum.

Introduction

Amisorb (polyaspartate) is a new product offered by Amilar International. Company literature states that polyaspartate works to artificially increase the area occupied by plant roots, which results in greater availability of mineral nutrients to plants. These field experiments were designed to evaluate the potential of Amisorb to increase nutrient uptake and yield of corn and grain sorghum.

Procedures

The irrigated corn experiment was conducted on a Crete silt loam soil at the Irrigation Experiment Field near Scandia. The grain sorghum experiment was conducted at the North Central Kansas Experiment Field, near Belleville also on a Crete silt loam soil. The corn experiment was located on a site that had been ridge-tilled for 5 years. The grain sorghum experiment was conducted under dryland, no-tillage conditions. Treatments in the corn study consisted of a no-starter check, starter alone (30 lb N and 30 lb P_2O_5), starter plus 2 qt/a Amisorb, starter plus Asset (6 oz/a), and starter plus ACA (10 oz/a). Asset is a product manufactured by Setre Chemical Co. containing 2.00% water-soluble magnesium. ACA is a product offered by United Agri Products and contains by weight 15% nitrogen and 17% zinc. Treatments in the grain sorghum study included a no-starter check, starter alone, and starter plus 2 qt/a Amisorb. Starter fertilizer was applied 2 inches to the side and 2 inches below the seed at planting. Liquid ammonium polyphosphate (10-34-0) and urea-ammonium nitrate solution (28% UAN) were used as starter fertilizer sources. Nitrogen as anhydrous ammonia was knifed in the row middles immediately after planting to bring all corn plots to a total of 180 lb N/a and all sorghum plots to a total of 120 lb N/a. Analysis by the KSU Soil Testing Lab showed that initial soil pH was 6.4, organic matter was 1.9%, Bray-1 P was 30 ppm, and exchangeable K was 310 ppm in the top 6 inches of soil at the corn experiment site. Soil test results at the grain sorghum site were: pH 6.6%, 45 ppm Bray-1 P, and 308 ppm exchangeable K. The corn hybrid Pioneer 3394 was planted on 28 April, and the grain sorghum hybrid Dekalb 45 was planted on 21 May.

Results

Starter fertilizer increased corn grain yield by 34 bu/a over that of the no-starter check (Table 2). Addition of 2 qt/a Amisorb to starter fertilizer increased grain yields by 6 bu/a over the starter-alone treatment. Addition of Asset or ACA to the starter fertilizer mix did not significantly improve grain yield over the starter-alone treatment.

Starter fertilizer increased growth and nutrient uptake of grain sorghum compared to the no-starter check (Table 3). The addition of Amisorb to the starter fertilizer mix did not improve dry matter production, nutrient uptake, or yield of grain sorghum.

Table 2. Effects of starter fertilizer and Amisorb on yield, 6-leaf stage whole plant dry matter, and nutrient uptake of corn, Irrigation Experiment Field, Scandia, KS 1997.

Treatment	Yield	6-Leaf Whole Plant Dry Weight	6-Leaf Whole Plant N	6-Leaf Whole Plant P
	bu/a		lb/a	
Amisorb + Starter*	218a**	206a	18.6a	2.2a
Starter alone	212b	178b	15.3b	1.8b
Starter +Asset	210b	175b	15.3b	1.8b
Starter + ACA	209b	189ab	16.5ab	1.9ab
No Starter	178c	136c	10.6c	1.3c
CV%	1.4	9.5	9.9	10.2

*Starter fertilizer consisted of 30 lb N and 30 lb P2O5/a
** Means followed by the same letter are not significantly different at the 5% level of probability.

Table 3. Effects of starter fertilizer and Amisorb on yield, 6-leaf whole plant dry matter, and nutrient uptake of grain sorghum, North Central Kansas Experiment Field, Belleville 1997.

Treatment	Yield	6-Leaf Whole Plant Dry Weight	6-Leaf Whole Plant N	6-Leaf Whole Plant P
	bu/a		lb/a	
Starter + Amisorb	122a**	485a	10.6a	1.2a
Starter Alone*	122a	488a	10.8a	1.2a
No Starter	95b	337b	6.1b	0.7b
CV%	3.7	2.6	4.5	1.3

*Starter fertilizer consisted of 30 lb N and 30 lb P2O5/a
**Means followed by the same letter are not significantly different at the 0.05 level of probability.

STARTER FERTILIZER INTERACTIONS WITH CORN AND GRAIN SORGHUM HYBRIDS

W. Barney Gordon, Dale L. Fjell, and David A. Whitney

Summary

Two studies evaluated starter fertilizer application on corn and grain sorghum hybrids grown in a dryland, no-tillage production system on a soil high in available phosphorus (P). Treatments consisted of 12 corn or 12 grain sorghum hybrids grown with or without starter fertilizer. Starter fertilizer (30 lb N and 30 lb/a P_2O_5) was applied 2 inches to the side and 2 inches below the seed at planting. In both the corn and sorghum experiments, starter fertilizer improved growth of all hybrids at the 6-leaf stage of growth. Whole plant N and P uptakes at the 6-leaf stage also were improved by the use of starter fertilizer. Starter fertilizer improved grain yield of some corn and grain sorghum hybrids but had no effect on the yield of other hybrids.

Introduction

Maintenance of ground cover from crop residue to control soil erosion has become an important factor in crop production in Kansas. No-tillage systems have been shown to be effective in maintaining crop residues and reducing soil erosion losses. Early-season plant growth and yield can be poorer in no-tillage systems than in conventional systems. The large amount of surface residue maintained with no-tillage systems can reduce seed-zone temperature. Lower than optimum soil temperature can reduce the availability of nutrients. However, starter fertilizers can be applied to place nutrients within the rooting zone of young seedlings for better availability. Corn and grain sorghum hybrids may differ in rooting characteristics and availability to extract and use nutrients. These studies evaluate the differential responses of corn and grain sorghum hybrids to starter fertilizer.

Procedures

These field studies were conducted at the North Central Kansas Experiment field near Belleville on a Crete silt loam soil. Both the corn and grain sorghum studies were initiated in 1995. Analysis by the KSU Soil Testing Lab showed that in the corn experimental area, the initial soil pH was 6.1, organic matter content was 2.4%, Bray-1 P was 43 ppm, and exchangeable K was 380 pm in the top 6 inches of soil. Analysis in the grain sorghum area showed that pH was 6.5, organic matter was 2.5%, Bray-1 P was 45 ppm, and exchangeable K was 420 ppm. Both corn and grain sorghum sites had been in no-tillage production systems for 3 years prior to the establishment of these studies. The experimental design for both studies was a randomized complete block with a split-plot arrangement. Whole plots were corn or grain sorghum hybrids. The split plots consisted of starter (30 lb N and 30 lb P_2O_5/a) or no starter fertilizer. Starter fertilizer was applied 2 inches to the side and 2 inches below the seed at planting. Liquid ammonium polyphosphate (10-34-0) and urea-ammonium nitrate solution (28% UAN were used as starter fertilizer sources. Nitrogen as anhydrous ammonia was knifed in immediately after planting to bring all corn plots to a total of 180 lb/a and grain sorghum plots to a total of 120 lb/a. In 1997, corn was planted on 22 April, and grain sorghum was planted on 19 May.

Results

Corn Study

Starter fertilizer improved early-season growth and nutrient uptake of all hybrids tested (Table 4). When averaged over hybrids, dry matter at the 6-leaf stage averaged 178 lb/a without starter and 360 lb/a with starter. Dryland corn in central Kansas is normally planted as early in April as possible, so that pollination occurs in June when temperature and moisture conditions are more favorable than in July, when conditions are normally hot and dry. Any practice that promotes earliness often increases yield. Starter fertilizer significantly decreased the number of days from emergence to mid-silk in Pioneer 3489, Pioneer 3346, Pioneer 3394, Cargill 7777, Dekalb 591, Northrup King 6330, and Northrup King 7333 but did not affect maturity in Pioneer 3563, Cargill 6327, Dekalb 626, Dekalb 646, and ICI 8599 (Table 5). Starter fertilizer increased grain yield of some hybrids but had no effect on the yields of other hybrids (Table 5). When averaged over the 3 years of the experiment, the average yield increase for the seven hybrids that responded to starter fertilizer was 17 bu/a.

Grain Sorghum Study

Starter fertilizer improved the early-season growth and nutrient uptake of all hybrids tested (Table 6). When averaged over hybrids, dry matter at the 6-leaf stage was 158 lb/a greater with starter than without. Starter fertilizer can be quite helpful in improving early season growth in cool soils. In northern Kansas, an early frost can occur before the crop is mature. Starter fertilizer can hasten maturity and avoid late-season damage by low temperature. Starter fertilizer significantly reduced the number of days from emergence to mid-bloom in 8 of the 12 hybrids tested (Table 7). Starter fertilizer increased grain yield of some hybrids but had no effect on yield of other hybrids (Table 7). When averaged over the 3 years of the experiment, yield increase of the responding hybrids was 15 bu/a.

Table 4. Mean effects of corn hybrid and starter fertilizer on whole-plant dry weight and N and P uptakes at the 6-leaf stage of growth, North Central Kansas Experiment Field, Belleville, KS, 1997.

Variable	Dry Weight	N Uptake	P Uptake
		lb/a	
Hybrid			
Pioneer 3563	236	7.2	0.79
Pioneer 3489	245	7.9	0.88
Pioneer 3346	248	7.9	0.80
Pioneer 3394	250	8.1	0.85
Cargill 6327	265	8.2	0.86
Cargill 7777	268	9.0	0.88
Dekalb 591	251	7.2	0.76

(Continued)

Table 4. Mean effects of corn hybrid and starter fertilizer on whole-plant dry weight and N and P uptakes at the 6-leaf stage of growth, North Central Kansas Experiment Field, Belleville, KS, 1997.

Variable	Dry Weight	N Uptake	P Uptake
		lb/a	
Hybrid			
Dekalb 626	245	7.5	0.90
Dekalb 646	240	7.5	0.80
Northrup King 7333	246	8.2	0.90
Northrup King 6330	238	7.9	0.75
ICI 8599	230	6.9	0.76
LSD(0.05)	12	0.4	0.05
Starter			
With	360	5.2	1.15
Without	178	10.3	0.48
LSD(0.05)	27	0.85	0.08

Table 5. Starter fertilizer effects on grain yield and number of days from emergence to mid-silk of corn hybrids, North Central Kansas Experiment Field, Belleville, KS, 1997.

Hybrid	Starter	Yield, 1997	Yield, 1995-1997	Number of Days to Mid-Silk, 1997
		bu/a		
Pioneer 3563	With	85	106	74
	Without	84	105	74
Pioneer 3489	With	120	135	72
	Without	111	116	78
Pioneer 3346	With	115	142	74
	Without	102	122	80
Pioneer 3394	With	112	144	75
	Without	98	127	80
Cargill 6327	With	98	124	79
	Without	97	124	80
Cargill 7777	With	128	161	76
	Without	116	149	82
Dekalb 591	With	110	141	72
	Without	95	122	79
Dekalb 626	With	101	124	79
	Without	102	124	79
Dekalb 646	With	106	127	81
	Without	105	126	82
Northrup King 7333	With	126	126	76
	Without	110	110	82
Northrup King 6330	With	137	137	75
	Without	120	120	79
ICI 8599	With	120	120	77
	Without	120	120	77
Hybrid x Starter LSD(0.05)		7	9	2

Table 6. Mean effects of grain sorghum hybrids and starter fertilizer on whole-plant dry weight and N and P uptakes at the 6-leaf stage of growth, North Central Kansas Experiment Field, Belleville, KS, 1997.

Variable	Dry Weight	N Uptake	P Uptake
		lb/a	
Hybrid			
Pioneer 8699	302	9.5	0.98
Pioneer 8505	320	9.5	0.99
Pioneer 8310	329	8.9	1.02
Dekalb 48	340	10.5	1.10
Dekalb 40Y	325	10.0	1.25
Dekalb 39Y	298	9.6	1.12
Dekalb 51	320	9.5	1.08
Dekalb 55	325	9.8	1.10
Pioneer 8522Y	305	9.7	0.99
Northrup King KS 383Y	308	9.8	1.05
Northrup King 524	315	9.7	1.04
Northrup King 735	318	9.5	1.04
LSD(0.05)	NS*	NS	NS
Starter			
With	396	12.3	1.31
Without	232	7.1	0.80
LSD(0.05)	25	0.8	0.49

* Not significant at the 0.05 level of probability.

Table 7. Starter fertilizer effects on grain yield and number of days from emergence to mid-bloom of grain sorghum hybrids, North Central Kansas Experiment Field Belleville, KS, 1997.

Hybrid	Starter	Yield, 1997	Yield, 1995-1997	Number of Days to Mid-Bloom, 1997
			bu/a	
Pioneer 8699	With	108	109	56
	Without	104	107	57
Pioneer 8505	With	139	138	56
	Without	129	122	61
Pioneer 8310	With	155	133	65
	Without	144	118	71
Dekalb 48	With	139	129	62
	Without	128	115	69
Dekalb 40Y	With	150	131	63
	Without	137	113	70
Dekalb 39Y	With	118	104	62
	Without	118	103	62
Dekalb 51	With	149	134	62
	Without	136	115	68
Dekalb 55	With	149	130	66
	Without	134	115	72
Pioneer 8522Y	With	138	127	63
	Without	129	115	69
Northrup King KS 383Y	With	126	117	62
	without	126	117	62
Northrup King KS 524	With	136	128	61
	Without	128	114	67
Northrup King KS 735	With	152	128	65
	Without	151	127	65
Hybrid x Starter LSD(0.05)		5	7	2

RESPONSE OF CORN AND GRAIN SORGHUM HYBRIDS TO STARTER FERTILIZER COMBINATIONS

W. Barney Gordon and Gary M. Pierzynski

Summary

Previous research at the North Central Kansas Experiment Field showed that some corn and grain sorghum hybrids grown under reduced-tillage conditions responded to starter fertilizer containing nitrogen (N) and phosphorus (P), but others did not. Little information is available concerning variability of responsiveness among corn and grain sorghum hybrids to starters containing a complete complement of nutrients. These field studies evaluated the response of four corn hybrids (Pioneer 3563, Pioneer 3346, Dekalb 591, and Dekalb 646) or four grain sorghum hybrids (Pioneer 8699, Dekalb 40Y, Dekalb 48, and Northrup King KS 735) to starter fertilizer combinations containing N, P, potassium (K), sulfur (S), and zinc (Zn). The corn experiment was conducted on a Carr fine sandy loam soil located in the Republican River Valley near Scandia, KS. The grain sorghum experiment was conducted at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Starter fertilizer containing N and P increased whole-plant dry weight at the V-6 stage for all corn hybrids tested. Grain yields of two hybrids (Pioneer 3563 and Dekalb 646) did not respond to starter fertilizer, regardless of elemental composition. Starter fertilizer containing N and P increased grain yields of Pioneer 3346 and Dekalb 591 by 33 and 48 bu/a, respectively, compared to the no-starter check. The addition of 10 lb/a S to the starter fertilizer mix resulted in an additional grain yield increase for both Pioneer 3346 and Dekalb 591. The addition of K or Zn to the starter fertilizer did not result in any additional yield benefit. Starter fertilizer increased whole-plant dry matter production at the V-6 stage n in all grain sorghum hybrids tested. Starter fertilizer containing N and P increased grain yields of Dekalb 40Y and Dekalb 48 by 36 and 19 bu/a, respectively. Grain yields of Pioneer 8699 and Northrup King KS 735 did not respond to starter fertilizer. Addition of K, S, or Zn to the starter fertilizer mix did not significantly increase early-season dry matter production or grain yield for any grain sorghum hybrid.

Introduction

Reduced-tillage production systems are being used by an increasing number of farmers in the central Great Plains. Early season growth is often poorer in conservation tillage systems than in conventionally tilled systems. Cool soil temperature at planting time can reduce nutrient uptake of crops, even on soils that are not low in available nutrients. Placing fertilizer in close proximity to the seed at planting time can alleviate the detrimental effects of cool soil temperature on plant growth and development. Previous research at the North Central Kansas Experiment Field showed that some corn and grain sorghum hybrids responded well to the application of starter fertilizer containing N and P in a 1:1 ratio, whereas other hybrids did not respond at all. Little information is available concerning variability in responsiveness among corn and grain sorghum hybrids to starter fertilizer containing a complete complement of nutrients. The objectives of these experiments were to determine the variability in starter fertilizer responsiveness among corn and grain sorghum hybrids grown under reduced-tillage conditions and to ascertain whether variability in hybrid responsiveness is influenced by starter fertilizer composition.

Procedures

The ridge-tilled, furrow-irrigated corn study was conducted on a farmer's field in the Republican River Valley near Scandia, KS on a Carr sandy loam soil. Analysis by the KSU Soil Testing Lab. showed that the initial pH was 7.2, organic matter was 1%, Bray-1 P was 21 ppm, exchangeable K was 280 ppm, and SO_4-S was 12 ppm in the surface 6 inches of soil. The site had been in ridge-tillage for 4 years prior to the establishment of this study. The grain sorghum experiment was conducted at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Soil test values for this site were: pH 6.5, 2.5% organic matter content, 44 ppm Bray-1 P, 350 ppm exchangeable K, and 20 ppm SO_4-S in the top 6 inches of soil. The site had been in no-tillage production for 3 years prior to the establishment of the present no-tillage study. Corn hybrids used in the experiment were Pioneer 3563, Pioneer 3346, Dekalb 591, and Dekalb 646. Grain sorghum hybrids included in the experiment were Pioneer 8699, Northrup King KS 735, Dekalb 40Y, and Dekalb 48. The liquid starter fertilizer treatments used in both experiments are given in Table 8. Starter fertilizer was applied 2 inches to the side and 2 inches below the seed at planting. The corn experiment was planted on 28 April at the rate of 30,000 seed/a. The grain sorghum experiment was planted on 18 May at the rate of 64,000 seed/a. Immediately after planting, N was balanced on all plots to give a total of 200 lb/a in the corn study and 150 lb/a in the grain sorghum study. The fertilizer sources used in the experiments were: urea-ammonium nitrate solution (28% UAN), ammonium polyphosphate (10-34-0), KCL, ammonium thiosulfate, and liquid Zn-NH_3 complex. Whole-plant samples were taken at the V-6 stage for determination of dry weight and nutrient concentrations. Crops were combine harvested in early to mid-October. The experimental design was a two-factor randomized complete block with four replications.

Results

Corn Study

Starter fertilizer containing N and P improved whole-plant dry matter production at the V-6 stage of all hybrids tested (Table 9). Additional response was achieved with the addition of S to the starter fertilizer mix. Addition of K or Zn did not result in any additional dry matter production.

Starter fertilizer containing N and P increased grain yields of Pioneer 3346 and Dekalb 591 by 33 and 48 bu/a, respectively, compared to the no-starter check (Table 10). When compared to starter fertilizer containing only N and P, addition of S to the starter fertilizer mix resulted in an additional 9 bu/a yield increase for Pioneer 3346 and an additional 10 bu/a increase for Dekalb 591. Addition of K or Zn to the starter fertilizer mix did not improve grain yield. Two hybrids (Pioneer 3563 and Dekalb 646) did not show any yield response to starter fertilizer, regardless of elemental composition. This is consistent with the results of previous studies using these two hybrids.

Grain Sorghum Study

Starter fertilizer containing N and P increased whole-plant dry matter at the V6 stage of all grain sorghum hybrids tested compared to the no starter check treatment (Table10). Addition of K, S, or Zn to the starter fertilizer mix did not further improve dry matter production weight on this medium-textured silt-loam soil. Starter fertilizer containing N and P increased grain yields of Dekalb 40Y and Dekalb 48 by 37 and 19 bu/a, respectively, compared to the no starter check treatment (Table 11). Yields of two grain sorghum hybrids (Pioneer 8699 and Northrup King KS 735) did not respond to starter fertilizer. This is consistent with results from previous studies at this location. Addition of K, S, or Zn to the starter fertilizer mix did not further increase grain yield for any of the hybrids.

Conclusion

Starter fertilizer improved early-season growth and nutrient concentration in all corn and grain sorghum hybrids included in the experiments. However, this early-season response did not translate into grain yield increases for all hybrids. Results of this work indicate that responses to starter fertilizer can be economical for some hybrids even on soils that are not low in available nutrients, particularly when corn or grain sorghum are planted early in a high-residue production system.

Table 8. Starter fertilizer treatments used in studies with corn and grain sorghum, Scandia and Belleville, KS 1997.

Treatment	N	P_2O_5	K_2O	S	Zn
			lb/a		
1	0	0	0	0	0
2.	30	30	0	0	0
3.	30	30	20	0	0
4.	30	30	0	10	0
5.	30	30	0	0	1
6.	30	30	20	10	1

Table 9. Effects of starter fertilizer combinations on whole-plant dry weight and nutrient concentrations at V-6 stage of corn hybrids, Scandia, 1997.

Treatment	Dry Weight	N	P	K	S	Zn
	lb/a		%			ppm
<u>Hybrid</u>						
Pioneer 3563	347	2.61	0.273	4.23	0.238	0.249
Pioneer 3346	340	2.61	0.310	4.42	0.241	0.260
Dekalb 591	329	2.67	0.332	4.30	0.258	0.264
Dekalb 646	359	2.65	0.311	4.41	0.250	0.273
LSD(0.05)	18	NS*	0.021	NS	NS	NS
<u>Starter Combination</u>						
N P_2O_5 K_2O SO_4 Zn						
0 0 0 0 0	162	2.06	0.247	3.98	0.180	0.275
30 30 0 0 0	351	2.81	0.321	4.14	0.207	0.239
30 30 20 0 0	370	2.71	0.327	4.72	0.230	0.227
30 30 0 10 0	413	2.75	0.312	4.21	0.319	0.249
30 30 0 0 1	360	2.70	0.303	4.19	0.214	0.291
30 30 20 10 1	407	2.80	0.329	4.80	0.329	0.288
LSD (0.05)	21	0.21	0.023	0.22	0.021	0.011

*Not significant at the 0.05 level of probability.

Table 10. Effects of starter fertilizer combinations on grain yield of corn hybrids, Scandia, KS.

Hybrid	Starter Fertilizer					Yield, 1997	Yield, 1996-1997
	N	P_2O_5	K_2O	SO_4	Zn		
			lb/a			bu/a	
Pioneer 3563	0	0	0	0	0	180	201
	30	30	0	0	0	181	202
	30	30	20	0	0	187	205
	30	30	0	10	0	182	201
	30	30	0	0	1	189	205
	30	30	20	10	1	186	204
Pioneer 3346	0	0	0	0	0	140	147
	30	30	0	0	0	173	190
	30	30	20	0	0	167	187
	30	30	0	10	0	182	204
	30	30	0	0	1	170	190
	30	30	20	10	1	180	204
Dekalb 591	0	0	0	0	0	137	151
	30	30	0	0	0	185	200
	30	30	20	0	0	187	200
	30	30	0	10	0	195	212
	30	30	0	0	1	182	199
	30	30	20	10	1	196	213
Dekalb 646	0	0	0	0	0	188	195
	30	30	0	0	0	183	194
	30	30	20	0	0	181	192
	30	30	0	10	0	182	194
	30	30	0	0	1	187	197
	30	30	20	10	1	183	193
LSD (0.05)						7	9

*Not significant at the 0.05 level of probability.

Table 11. Effects of starter fertilizer combinations on whole-plant dry weight and nutrient concentrations at V-6 stage of grain sorghum hybrids, Belleville, KS, 1997.

Treatment	Dry Weight	N	P	K	S	Zn
	lb/a			%		ppm
Hybrid						
Pioneer 8699	537	2.44	0.252	3.69	0.182	0.268
Northrup King KS 735	557	2.44	0.250	3.71	0.185	0.269
Dekalb 40Y	554	2.48	0.258	3.78	0.186	0.278
Dekalb 48	563	2.48	0.256	3.80	0.186	0.279
LSD (0.05)	NS*	NS	NS	NS	NS	NS
Starter Combination						
N P_2O_5 K_2O SO_4 Zn						
0 0 0 0 0	327	1.79	0.200	3.61	0.176	0.260
30 30 0 0 0	612	2.60	0.263	3.70	0.179	0.268
30 30 20 0 0	603	2.60	0.266	3.86	0.176	0.266
30 30 0 10 0	611	2.60	0.261	3.74	0.196	0.265
30 30 0 0 1	606	2.61	0.268	3.72	0.181	0.288
30 30 20 10 1	596	2.60	0.265	3.88	0.198	0.287
LSD(0.05)	66	0.12	0.012	0.12	0.010	0.011

*Not significant at the 0.05 level of probability.

Table 12. Effects of starter fertilizer combinations on yield of grain sorghum hybrids, Belleville, KS, 1997.

	Starter Fertilizer						
Hybrid	N	P_2O_5	K_2O	SO_4	Zn	Yield, 1997	Yield 1996-1997
			lb/a			bu/a	
Pioneer 8699	0	0	0	0	0	123	127
	30	30	0	0	0	118	123
	30	30	20	0	0	127	127
	30	30	0	10	0	122	126
	30	30	0	0	1	120	124
	30	30	20	10	1	126	127
Northrup King KS 735	0	0	0	0	0	117	122
	30	30	0	0	0	123	125
	30	30	20	0	0	115	120
	30	30	0	10	0	119	122
	30	30	0	0	1	118	121
	30	30	20	10	1	119	123
Dekalb 40Y	0	0	0	0	0	91	101
	30	30	0	0	0	128	131
	30	30	20	0	0	128	131
	30	30	0	10	0	130	131
	30	30	0	0	1	126	130
	30	30	20	10	1	132	133
Dekalb 48	0	0	0	0	0	97	107
	30	30	0	0	0	116	129
	30	30	20	0	0	122	133
	30	30	0	10	0	123	132
	30	30	0	0	1	117	129
	30	30	20	0	1	124	132
LSD (0.05)						9	11

SULFUR SOURCE STUDY

W. Barney Gordon

Procedures

A separate experiment was conducted in an area adjacent to the starter fertilizer study with corn on the Carr sandy loam soil to evaluate effectiveness of ammonium thiosulfate (ATS) and potassium thiosulfate (KTS). Two hybrids (Pioneer 3563 and Pioneer 3346) were used. Starter fertilizer treatments included two rates of sulfur (10 and 20 lb/a) supplied from either ATS or KTS, or a no-starter check, and an N-P only starter. Starter fertilizer was placed 2 inches to the side and 2 inches below the seed at planting. The potassium source used in the treatments containing ATS was KCL. Nitrogen was balanced on all plots to give a total of 200 lb/a.

Results

Grain yield of the corn hybrid Pioneer 3563 was not affected by starter fertilizer regardless of elemental composition or fertilizer source (Table 13). Starter fertilizer containing only N and P increased grain yields of Pioneer 3346 by 22 bu/a. Further yield increases were obtained when S was added to the starter fertilizer. Grain yields were not affected by S source or rate. Good early-season growth responses resulted from the addition of S to the starter fertilizer. Increasing S rate increased whole-plant dry weight and tissue S concentration at the V-6, stage but no significant differences occurred between ATS and KTS treatments.

Table 13. Effects of starter fertilizer on grain yield, whole-plant dry weight, and sulfur concentration at V-6 stage of corn hybrids, Scandia, KS., 1997.

	Starter Fertilizer							
Hybrid	N	P	K	S	S-Source	Yield	Dry Weight	S Conc.
						bu/a	lb/a	%
Pioneer 3563	0	0	0	0		179	185	0.208
	30	30	0	0		181	350	0.212
	30	30	20	10	ATS	182	460	0.326
	30	30	20	20	ATS	184	498	0.395
	30	30	20	10	KTS	186	480	0.335
	30	30	20	20	KTS	184	510	0.398
Pioneer 3346	0	0	0	0		148	156	0.200
	30	30	0	0		170	348	0.209
	30	30	20	10	ATS	186	488	0.335
	30	30	20	20	ATS	184	524	0.395
	30	30	20	10	KTS	186	500	0.340
	30	30	20	20	KTS	188	532	0.397
LSD(0.05)						7	28	0.021

EFFECTS OF PLACEMENT, RATE, AND SOURCE OF STARTER FERTILIZER CONTAINING POTASSIUM ON CORN AND SOYBEAN PRODUCTION

W. Barney Gordon

Summary

Field studies were conducted at the Irrigation Experiment Field near Scandia Kansas on a Crete silt loam soil (fine, montmorillonitic, mesic Pachic Arguistoll). Starter fertilizer (7-21-7) included two sources of potassium (K): sulfate of potassium (K_2SO_4) and potassium chloride (KCL). The test also used two placement methods (in-furrow with the seed and 2 inches to the side and 2 inches below the seed) and five application rates (50, 75, 100, 150, and 200 lb/a of 7-21-7). A no-starter check plot also was included. Sulfur rates were balanced so that all plots received the same amount, regardless of K source. Experiments were conducted with both corn and soybeans. For the corn experiment, nitrogen (N) as urea-ammonium nitrate solution (28% UAN) was applied immediately after planting so that all plots received 200 lb/a N. Soybeans received no additional N. When liquid 7-21-7 starter fertilizer containing KCL was placed in-furrow, grain yield, plant stand, V6-stage dry matter, and K-uptake were reduced in both the corn and soybean experiments. In the corn experiment, starter fertilizer containing KCL applied at the 50 lb/a rate reduced yields by 20 bu/a compared to the same rate applied 2 inches to the side and 2 inches below the seed (2 x 2). Corn yield was reduced 43 bu/a when starter fertilizer containing KCL was applied in-furrow at the 200 lb/a rate. When starter fertilizer containing sulfate of potassium was placed in-furrow with corn seed, no yield or population reduction was seen, except at the 200 lb/a rate. Corn grain yield was 11 bu/a less when 200 lb/a 7-21-7 was applied in-furrow as compared to 2 x 2 placement. When starter fertilizer containing KCL as the K source was placed in-furrow with soybean seed, yields and plant populations were reduced regardless of rate. Yields and populations of soybean declined when in-furrow rates of 7-21-7 starter containing sulfate of potassium exceeded 100 lb/a.

Procedures

This irrigated ridge-tilled field experiment was conducted at the Irrigation Experiment Field near Scandia, KS on a Crete silt loam soil. Analysis by the KSU Soil Testing Lab showed that in the corn experimental area, initial soil pH was 6.4; organic matter content was 2.4%; and Bray-1 P and exchangeable K in the top 6 inches of soil were 43 and 380 ppm, respectively. In the soybean area, soil test results showed that the initial pH was 6.5, organic matter content was 2.2%, Bray-1 P was 45 ppm, and exchangeable K was 350 ppm in the top 6 inches of soil. The experimental design was a randomized complete block with three factors. Both the corn and soybean tests included starter fertilizer (7-21-7) made with two potassium (K) sources applied either in-furrow with the seed or 2 inches to the side and 2 inches below the seed (2 x 2) at five different rates. A no-starter check also was included. The two sources of K were sulfate of potassium (SOP) and potassium chloride (KCL). A liquid 7-21-7 fertilizer was made using ammonium polyphosphate (10-34-0) and either SOP or KCL and was applied at 50, 75, 100, 150, and 200 lb/a. Sulfur was balanced so that all plots received the same amount. Nitrogen as 28% UAN also was balanced on all corn plots to give a total of 200 lb/a. The soybean experiment received no additional N. The corn hybrid Pioneer 3394 was planted on 28 April at the rate of 31,000 seed/a. The soybean variety Dekalb CX 377 was planted on 12 May at the rate of 200,000 seed/a in 30 inch rows. Both the corn and soybeans were grown in a ridge-tillage production system. Soil water was monitored in both experimental areas, and crops were furrow-irrigated when 50% of the available soil water in the top 24 inches of soil was depleted. Stand counts were taken 3 weeks after emergence. Whole-plant samples (20 plants per plot) were taken at the V-6 stage (in corn, stage at which six leaves with collars showing are present and in soybeans, stage at which seven nodes have leaves with completely unfolded leaflets). Crops were harvested for determination of yield.

Results

The 1997 growing season was characterized by below-normal rainfall and temperature in April and May. A 31^{0}F temperature was recorded on May 11. Early-season growth of both corn and soybeans was slowed by the cool temperatures.

Corn grain yields were affected by a starter fertilizer source x placement x rate interaction (Table 14). When SOP was used as the K source in the 7-21-7 starter fertilizer and placed in-furrow with the seed, grain yields were not different than those with fertilizer placed 2 x 2, except at the 200 lb/a rate. When 200 lb/a of 7-21-7 starter fertilizer was applied in-furrow, yields were 11 bu/a less than when the same rate was applied 2 x 2. Plant population and whole-plant dry weight and K uptake at the V6 stage all were reduced by an in-furrow application of 200 lb/a 7-21-7 containing SOP. When KCL was used as the K source for 7-21-7 starter fertilizer placed in-furrow, yields were reduced at all application rates compared to the 2 x 2 placement. A 50 lb/a in-furrow application of 7-21-7 containing KCL reduced grain yield by 20 bu/a and plant population by over 4000 plants/a compared to a 2 x 2 application. At the 200 lb/a rate, yields were reduced by 43 bu/a with in-furrow application of starter fertilizer containing KCL.

When starter fertilizer containing KCL was placed in-furrow with the soybean seed, yields, plant population, whole-plant dry matter production, and K uptake all were reduced regardless of rate (Table 15). At the 50 lb/a rate of 7-21-7 containing KCL, yields were 11 bu/a less when the fertilizer was placed in-furrow than when placed 2 inches to the side and 2 inches below the seed. At the 200 lb/a rate of 7-21-7 placed in-furrow, yields were reduced 21 bu/a. Yields and population of soybean declined when in-furrow rates of 7-21-7 starter fertilizer containing SOP exceeded 100 lb/a.

In both corn and soybean experiments, in-furrow applications of starter fertilizer containing SOP resulted in less salt injury than those containing KCL. In corn, significant stand loss occurred only when rates of 7-21-7 containing SOP exceeded 150 lb/a. In general, soybeans are more sensitive to in-furrow application of fertilizer than corn. Only when in-furrow rates of fertilizer containing SOP exceeded 100 lb/a did soybean stand loss occur. Even at low application rates, in-furrow application of fertilizer containing KCL reduced plant population and yield.

Table 14. Effects of placement, rate, and K source of 7-21-7 starter fertilizer on grain yield, population, and whole-plant dry matter and potassium uptake at V6 stage of corn, Scandia, KS, 1997.

Source	Placement	Rate of 7-21-7	Yield	Population	V6 Dry Weight	V6 K Uptake
		lb/a	bu/a	plants/a	lb/a	lb/a
		0*	185	31335	182	10.9
SOP**	In-furrow	50	222	31436	323	16.9
		75	225	31255	343	18.0
		100	226	31307	347	17.9
		150	227	31040	349	18.3
		200	221	28852	327	16.9
	2 x 2	50	217	31314	341	17.4
		75	224	31471	349	18.4
		100	227	31244	347	18.6
		150	232	31236	354	18.6
		200	232	31284	358	18.7
KCL***	In-furrow	50	200	26943	272	13.6
		75	195	25064	241	11.9
		100	191	24608	226	11.0
		150	189	24631	222	11.0
		200	184	23867	210	10.1
	2 x 2	50	220	31281	328	17.0
		75	226	31254	339	17.3
		100	226	31256	344	17.8
		150	228	31215	343	18.2
		200	227	31260	352	18.4
CV%			2.3	1.1	3.2	3.4
LSD 0.05****			9	450	18	1.5

* No-starter check plot was not included in statistical analysis.
** 7-21-7 Starter fertilizer made using sulfate of potassium (SOP) as the K source.
***7-21-7 Starter fertilizer made using potassium chloride (KCL) as the K source.
**** Three-way interaction LSD (placement x rate x K source).

Table 15. Effects of placement, rate, and K source of 7-21-7 starter fertilizer on yield, population, and whole-plant dry matter and potassium uptake at V6 stage of soybean, Scandia, KS, 1997.

Source	Placement	Rate of 7-21-7	Yield	Population	V6 Dry Weight	V6 K Uptake
		lb/a	bu/a	plants/a	lb/a	lb/a
		0*	61	198542	215	8.9
SOP**	In-furrow	50	72	196663	312	9.8
		75	72	197024	311	10.2
		100	69	191526	306	10.6
		150	54	156440	231	9.5
		200	52	156040	220	9.2
	2 x 2	50	73	198185	302	10.2
		75	74	197937	312	10.4
		100	73	197420	314	10.4
		150	74	198868	314	10.8
		200	72	198076	315	10.7
KCL***	In-furrow	50	56	153050	231	9.7
		75	51	156083	216	9.6
		100	51	156264	215	9.4
		150	51	157403	214	9.4
		200	51	156726	214	9.4
	2 x 2	50	67	184211	273	9.8
		75	73	197761	309	10.6
		100	73	197765	310	10.5
		150	73	196248	313	10.5
		200	72	195844	314	10.7
CV%			5.1	3.4	3.1	5.1
LSD (0.05)****			8	9560	22	0.8

*No-starter check plot was not included in statistical analysis.
**7-21-7 Starter fertilizer made using sulfate of potassium (SOP) as the K source.
***7-21-7 Starter fertilizer made using potassium chloride (KCL) as the K source.
****Three-way interaction LSD among placement, rate and K source.

WHITE FOOD-CORN PERFORMANCE TEST

W. Barney Gordon

Introduction

Increased marketing opportunities have created interest among area farmers to convert acres to white food-corn. White corn varieties have distinctive genetic traits for specific end-use purposes. These include dry or wet milling for snacks, cereals, or traditional southern foods. End-use processors require delivery of consistent grain with desirable milling qualities. This test is one of 13 locations included in a regional white corn performance test coordinated by Dr. L.L. Darrah with the USDA-ARS at the University of Missouri-Columbia. The 1997 test included 40 white hybrids and three yellow hybrid checks submitted by 13 commercial seed producers. Data were received from locations in Illinois, Indiana, Kansas, Kentucky, Missouri, Tennessee, and Texas.

Procedures

Anhydrous ammonia was applied on 20 March at the rate of 200 lb/a. The test was planted on 23 April at the rate of 30,000 seed/a. Starter fertilizer (100 lb/a 10-34-0) was applied 2 inches to the side and 2 inches below the seed at planting. Furrow-irrigations were applied on 2 July, 14 July, and 23 July, 3 inches of water at each irrigation. The test was harvested on 18 October with a modified E Gleaner plot combine.

Results

Grain yields in this test averaged 183 bu/a and ranged from 114.9 to 262 bu/a. Yield of white corn hybrids (39 commercial hybrids and one check hybrid) averaged 179 bu/a. The average yield of the three yellow corn hybrids included in the test (Pioneer 3245, Pioneer 3394, and B73xMo17) was 189 bu/a. Twelve of the 39 commercial white corn hybrids (Asgrow RX921W, Dekalb DK703W, IFSI 90-1, Pioneer 32H39, Pioneer 3287W, Pioneer X1156MW, Pioneer X1186MW, Vineyard V448W, Vineyard 449W, Vineyard 453W, Vineyard VX4596, and Wilson E9360) yielded more than 200 bu/a. Stalk lodging averaged 13.7% and ranged from 0.9 to 32.4%. Grain moisture at harvest averaged 14.9%.

Table 19. Grain yield, stand, lodging, ear height, grain moisture content, and days from planting to mid-silk of white corn hybrids, Scandia, KS.

Entry	Yield, 1997	Yield, 1996	Root Lodged	Stalk Lodged	Ear Height	Days to Mid-Silk	Moist
	bu/a	bu/a	%	%	in.		%
Asgrow RX 921W	211.4	--	0	1.4	49.3	83	15.2
Dekalb DK703W	213.6	180.0	0.00	19..3	41.7	85.3	14.7
Dekalb EXP764W	162.6	--	0.00	7.8	48.3	82.7	14.8
Dekalb EXP764WB	144.8	--	0.00	26..3	51.7	86.3	14.4
Dekalb EXP766W	149.4	--	0.00	9.4	39.0	84.3	14.6
Diener DB 115W	160.4	--	0.00	26.4	41.7	83.0	15.3
Garst 8320W	178.7	165.7	0.00	7.4	44.7	86.7	14.4
Garst 8490W	166.4	--	0.00	22.4	48.7	83.0	14.7
Hoegenmeyer 1125W	166.7	--	0.00	3.2	48.7	86.7	15.1
IFSI 90-1	201.4	179.7	0.00	31.6	55.7	84.3	14.8
IFSI 94-3	148.4	168.8	0.00	25.1	42.3	86.0	15.3
IFSI 95-1	150.7	186.6	0.00	26.9	41.7	85.3	15.5
IFSI 97-1	151.0	--	0.00	21.9	43.0	84.3	15.5
LG Seeds NB749W	145.7	190.8	0.00	0.9	45.0	86.7	14.9
Pioneer 32H39	262.4	225.9	0.00	7.0	40.3	82.3	14.8
Pioneer 3203W	155.4	212.8	0.00	0.9	40.3	87.0	14.4
Pioneer 3287W	217.5	212.7	0.00	0.9	45.3	83.3	14.7
Pioneer X1156MW	259.3	--	0.00	7.7	48.7	84.3	14.7
Pioneer X1186KW	195.6	--	0.00	1.8	40.7	84.0	14.7
Pioneer X1186MW	210.9	--	0.00	9.9	44.7	83.0	14.6
Sturdy Grow SG765W	179.0	193.2	0.00	27.7	50.7	84.3	14.5
Sturdy Grow SG777W	127.5	186.4	0.00	22.5	49.7	84.3	14.4
Sturdy Grow SG797W	196.2	170.1	0.00	7.0	54.3	86.3	14.8
Vineyard V442W	167.4	191.2	0.00	4.5	44.3	84.3	15.4
Vineyard V448W	212.5	205.4	0.00	17.0	40.3	85.3	15.1
Vineyard V449W	213.5	207.2	0.00	7.4	39.7	85.3	15.4
Vineyard V453W	212.0	210.3	0.00	9.1	50.3	84.7	14.7

(Continued)

Table 19. Grain yield, stand, lodging, ear height, grain moisture content, and days from planting to mid-silk of white corn hybrids, Scandia, KS.

Entry	Yield, 1997	Yield, 1996	Root Lodged	Stalk Lodged	Ear Height	Days to Mid-Silk	Moist
	bu/a	bu/a	%	%	in.		%
Vineyard VX44596	213.6	--	0.00	4.5	44.7	84.3	15.2
Whisnard 50AW	194.9	--	0.00	13.2	55.7	84.3	14.7
Whisnard 51AW	164.2	176.2	0.00	6.1	39.7	84.0	14.7
Whisnard 92AW	114.9	187.3	0.00	26.1	41.0	85.0	15.3
Wilson 1789W	196.0	184.2	0.00	20.8	48.3	87.3	15.4
Wilson E5003	170.4	--	0.00	3.1	50.3	85.3	14.6
Wilson E9352	193.1	--	0.00	2.7	51.3	85.7	15.4
Wilson E9360	225.7	--	0.00	4.5	55.3	85.3	15.4
Zimmerman Z62W	185.0	--	0.00	7.0	49.3	86.3	14.3
Zimmerman Z64W	187.2	153.5	0.00	18.9	51.0	85.7	15.5
Zimmerman Z72W	174.9	141.4	0.00	32.4	42.7	87.3	14.4
Zimmerman Z73W	169.7	184.5	0.00	13.9	41.3	87.7	14.3
White Check (K55xCI66)FR802	161.6	127.6	0.00	27.4	56.3	87.0	15.3
Yellow Check B73xMo17	157.1	193.5	0.00	26.3	50.7	86.0	14.6
Yellow Check Pioneer 3245	187.5	239.4	0.00	1.4	45.3	84.7	14.7
Yellow Check Pioneer 3394	223.4	219.6	0.00	13.7	40.3	82.0	14.3
Mean	183.2	182.2	0.00	7.3	46.4	85.0	14.9
LSD(0.05)	18.5	15.2		32.8	1.5	2.4	0.4
CV%	6.2	5.1			1.9	1.7	1.7

EFFECTS OF CROPPING SYSTEM AND NITROGEN FERTILIZATION ON NO-TILLAGE PRODUCTION OF GRAIN SORGHUM

W. Barney Gordon, David A. Whitney, and Dale L. Fjell

Summary

When averaged over N rates, 1982-1995 yields were 23 bu/a greater in sorghum rotated with soybeans than in continuous sorghum. When no N was applied, rotated sorghum yielded 32 bu/a greater than continuous sorghum. In the continuous system, grain sorghum yield continued to increase with increasing N rate up to 90 lb/a. In the soybean rotation, sorghum yields increased with increasing N rate only up to 60 lb/a. When averaged over N rate, no-tillage grain sorghum rotated with soybeans reached mid-bloom 7 days sooner than continuous grain sorghum. Two knife-applied N sources (anhydrous ammonia and 28% UAN) were evaluated during 1982-1989. No grain sorghum yield differences resulted from N source. The 16-year soybean yield average was 35 bu/a. Soybean yields were not affected by N applied to the previous grain sorghum crop. In 1996, four additional N rates (120, 150, 180, and 210 lb/a) were added to the experiment. Yields were greater in the rotated system than in continuous sorghum at all levels of N. Yields in the continuous system continued to increase with increasing N rate up to 90 lb/a. Yields in the rotated system were maximized with application of 60 lb/a N and were greater than yields of continuous sorghum at all levels of N.

Introduction

Crop rotations were necessary to maintain soil productivity before the advent of chemical fertilizers. Biological fixation of atmospheric nitrogen (N) is a major source of N for plants in natural systems. Biological fixation through legume-*Rhizobium* associations is utilized extensively in agricultural systems. Using a legume in a crop rotation system can reduce the N requirement for the following non-legume crop. Other benefits of legume rotations include: breaking disease and insect cycles, helping weed control programs, and decreasing the toxic effects of crop residues. This study evaluates N rates for continuous grain sorghum and grain sorghum grown in annual rotation with soybeans in a no-tillage production system.

Procedures

This study was established in 1980 at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Data are reported starting in 1982. Treatments included cropping system (continuous grain sorghum and grain sorghum rotated with soybeans) and N rates (0,30,60, and 90 lb/a). In 1982-1989, the two N sources anhydrous ammonia and urea-ammonium nitrate solution (28% UAN) were evaluated. Both N sources were knife-applied in the middles of rows from the previous year's crop. After 1989, anhydrous ammonia was used as the sole N source. In each year, N was knife-applied 7-14 days prior to planting. Grain sorghum or soybean was planted into old rows without tillage in mid-May to early June each year. Grain sorghum was planted at the rate of 60,000 seed/a, and soybeans were planted at the rate of 10 seed/foot in 30-inch rows. Soybean yields were not affected by N applied to the previous sorghum crop and, therefore, are averaged over all N rates. In 1996, four additional N rates (120,150, 180, and 210 lb/a were added to the experiment in order to further define N response.

Results

In the continuous grain sorghum system, grain yields (1982-1995) continued to increase with increasing N rate up to 90 lb/a (Table 20). Sorghum yields in the rotated system were maximized with an application of 60 lb/a N. When no N was applied, rotated sorghum yielded 32 bu/a greater than continuous sorghum. When four additional N rates were added, sorghum yields were greater in the soybean rotation than in the continuous system at all levels of N (Table 21). Addition of N alone did not make up yield losses in a continuous production system. Over the 16-year period, soybean yields averaged 35 bu/a and were not affected by N applied to the previous sorghum crop (Table 22). Two knife-applied N sources, anhydrous ammonia and 28% UAN, were evaluated from 1982-1989. When averaged over cropping system and N rate, yields were 60 and 59 bu/a for anhydrous ammonia and UAN, respectively. For the no-N check, the number of days from emergence to mid-bloom was 8 days shorter in the rotated system than in the continuous system (Table 20).

Table 20. Long-term effects of cropping system and nitrogen rate on grain sorghum yields and number of days from emergence to mid-bloom, North Central Kansas Experiment Field, Belleville, KS.

N Rate	Cropping Systems	Grain Yield 1982-1995	Days to Mid-Bloom 1992-1995
lb/a		bu/a	
0	Continuous	43	64
	Rotated	75	56
30	Continuous	59	61
	Rotated	84	55
60	Continuous	70	59
	Rotated	92	53
90	Continuous	80	58
	Rotated	92	53
System Means			
	Continuous	63	61
	Rotated	86	54
N Rate Means, lb/a			
0		59	60
30		72	58
60		81	56
90		86	56
LSD(0.05)	Cropping System x N Rate	9	1

Table 21. Effects of cropping system and nitrogen rate on grain sorghum yields, Belleville, KS.

N Rate	Cropping System	Yield 1996	Yield 1997	Average
lb/a			bu/a	
0	Continuous	92	51	72
	Rotated	120	88	104
30	Continuous	110	71	91
	Rotated	137	108	123
60	Continuous	131	110	121
	Rotated	164	128	146
90	Continuous	143	121	132
	Rotated	163	141	152
120	Continuous	148	122	135
	Rotated	162	144	153
150	Continuous	148	120	134
	Rotated	162	143	153
180	Continuous	148	121	135
	Rotated	162	144	153
210	Continuous	148	122	135
	Rotated	162	145	154
System Means				
	Continuous	134	105	120
	Rotated	154	130	142
N Rate, lb/a				
0		106	70	88
30		124	90	107
60		148	119	134
90		153	131	142
120		155	133	144
150		155	132	144
180		155	133	144
210		155	134	145

Table 21. Effects of cropping system and nitrogen rate on grain sorghum yields, Belleville, KS.

N Rate	Cropping System	Yield 1996	Yield 1997	Average
lb/a			bu/a	
LSD(0.05)	Cropping System x N-Rate	8	6	

Table 22. Yields of soybean grown in rotation with grain sorghum, North Central Kansas Experiment Field, Belleville, KS, 1982-1997.

Year	Yield	Year	Yield
			bu/a
1982	38	1990	30
1983	15	1991	12
1984	20	1992	58
1985	28	1993	56
1986	48	1994	32
1987	48	1995	41
1988	18	1996	61
1989	25	1997	36
		Average	35

KANSAS RIVER VALLEY EXPERIMENT FIELD

Introduction

The Kansas River Valley Experiment Field was established to study how to effectively manage and use irrigation resources for crop production in the Kansas River Valley. The Paramore Unit (formerly Topeka Unit) consists of 80 acres located 3.5 miles east of Silver Lake on US 24, then 1 mile south of Kiro, and 1.5 miles east on 17th street. The Rossville Unit consists of 80 acres located 1 mile east of Rossville or 4 miles west of Silver Lake on US 24.

Soils Description

Soils on the two fields are predominately in the Eudora series. Small areas of soils in the Sarpy, Kimo, and Wabash series also occur. The soils are well drained, except for small areas of Kimo and Wabash soils in low areas. Soil texture varies from silt loam to sandy loam, and the soils are subject to wind erosion. Most soils are deep, but texture and surface drainage vary widely.

1997 Weather Information

The frost free season was 10 days longer than the 183-day average. The last 32^0 F frost in the spring was on April 16 (average, April 20), and the first in the fall was on October 26 (average, October 20). Precipitation was above normal in October and November; below normal from December through March; above normal at Rossville but below normal at the Paramore Unit in April; below normal in May, June, and July; and above normal in August and September (Table 1). Precipitation totals for October, 1996 through September, 1997 were over 13 and 6 inches below normal for the Paramore and Rossville units, respectively. However, with irrigation, corn and soybean yields were excellent.

Table 1. Precipitation at the Kansas River Valley Experiment Field, 1996-1997.

	Rossville Unit		Paramore Unit	
Month	1996-1997	Avg.	1996-1997	Avg.
	inches		inches	
Oct.	4.30	0.95	2.52	0.95
Nov.	2.80	0.89	1.79	1.04
Dec.	0.02	2.42	0.04	2.46
Jan.	0.12	3.18	0.23	3.08
Feb.	2.88	4.88	1.37	4.45
Mar.	0.29	5.46	0.16	5.54
Apr.	5.02	3.67	2.94	3.59
May	3.13	3.44	2.32	3.89
June	2.38	4.64	1.49	3.81
July	2.04	2.97	2.61	3.06
Aug.	4.67	1.90	4.25	1.93
Sep.		1.24	1.83	1.43
Total	27.65	35.64	21.55	35.23

CORN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux

Summary

Fifteen herbicide treatments were evaluated in a preemergence (PRE) test and 22 were evaluated in an early postemergence (EP) test. Treatments in the PRE test, which included Balance and Axiom, resulted in serious injury. Some of the Balance treatments included rates that were actually too high for this coarse-textured, low organic matter soil, so significant injury was observed in the EP test. Differences in common sunflower and common lambsquarter control were observed in both tests, but all herbicide treatments resulted in good to excellent control of large crabgrass and Palmer amaranth. Untreated checks yielded only 19 and 17 bu/a in the PRE and EP tests, respectively.

Introduction

Weed competition can limit crop yields. Chemical weed control and cultivation have been used to control weeds in row crops. Two corn herbicide tests were conducted, a preemergence (PRE) test and an early postemergence test (EP). These studies included several of the newer herbicides for use on corn. The major weeds in these two tests were large crabgrass, Palmer amaranth, and common sunflower.

Procedures

Both tests were conducted on a Sarpy fine sandy loam soil previously cropped to soybeans with a pH of 6.8 and an organic matter content of 1.1 percent. Pioneer Brand hybrids 3335 and 3162IR were planted at 26,200 seeds/a in 30-inch rows on April 25. Anhydrous ammonia at 150 lbs N/a was applied preplant, and 10-34-0 fertilizer was banded at planting at 110 lbs/a. Herbicides were applied to the PRE and EP tests on April 25 and 26 and May 29 and June 3, respectively. The plots were not cultivated. The ratings for crop injury reported were made on May 22 for the PRE test and on June 19 for the EP test. Ratings reported for weed control were made on June 9 for the PRE test and on June 19 for the EP test. The first significant rainfall after PRE herbicide application was on April 30 (0.75 inches). Plots were harvested on September 29 using a modified Gleaner E combine.

Results

In the PRE test, considerable corn injury was observed with the Balance treatments (Table 2). The two higher rates of Balance would be considered too high for this coarse-textured, low organic matter soil. The Axiom + Atrazine treatment also had a significant amount of corn injury. Most treatments gave good control of large crabgrass, although control with Harness Xtra 5.6L and Guardsman was below 80%. All treatments resulted in excellent control of Palmer amaranth. Common sunflower control with several of the herbicide materials was not as good as usually would be expected, probably because of the low amount of rainfall following the preemergence applications. Balance + Atrazine gave the best control of sunflower, but this treatment caused serious injury. Dual II + Python had the lowest sunflower control and the lowest yield of 132 bu/a. The control plots yielded an average of only 19 bu/a. The Axiom + Balance treatment also had a low yield of 140 bu/a, which was more related to the serious injury than to weed control. Most of the other Balance treatments also gave lower yields than other treatments not having as much injury and similar weed control. The Bicep II Magnum treatment gave the highest yield (237 bu/a).

Very little injury was observed with the EP treatments 14 days after application (Table 3). Large crabgrass control was quite variable. This is largely attributed to the lack of rainfall following the preemergence grass herbicides. Palmer amaranth control was excellent with all treatments. Action had very little activity on common sunflower, as shown by its 47% control rating, and Basis Gold also gave poor control (63%). All other treatments gave excellent control of sunflower. Common lambsquarter control was also poor with Action, but all other treatments gave good to excellent control. The untreated check yielded only 17 bu/a. Yields of the treatments ranged from 83 to 175 bu/a, with the treatments having the best overall weed control generally having the highest yields.

Table 2. Weed control, corn injury, and grain yield with preemergent herbicides, Rossville, KS, 1997.

Treatment	Rate	Appl Time	Corn Inj. 28 DAT[1]	Weed Control, 45 DAT[2]			Grain Yield
				Lgcg	Paam	Cosf	
	prod./a		%		%		bu/a
Untreated check	---		0	0	0	0	19
Bicep II Magnum	2.1 qt	PRE	2	95	100	83	237
Harness Xtra 5.6L	1.7 qt	PRE	0	77	100	73	161
Guardsman	1.75 qt	PRE	0	75	100	72	158
Fultime	3.75 qt	PRE	7	95	100	77	215
Axiom	15.0 oz	PRE	22	90	100	83	170
+ Atrazine 90 DF	1.56 lb						
Axiom	15.0 oz	PRE	53	98	100	92	140
+ Balance	2.0 oz						
Balance	1.5 oz	PRE	40	95	100	80	172
Balance	2.0 oz	PRE	33	88	100	80	164
Balance	2.5 oz	PRE	42	97	100	93	193
Balance	2.0 oz	PRE	33	98	100	92	176
+ Harness	1.14 pt						
Balance	2.0 oz	PRE	25	97	100	87	207
+ Dual II	1.28 pt						
Balance	2.0 oz	PRE	50	97	100	100	160
+ Atrazine 4L	1.0 qt						
Broadstrike + Dual	2.07 pt	PRE	5	90	100	80	201
+ Atrazine 90 DF	1.11 lb						
Dual II	2.05 pt	PRE	2	85	100	68	132
+ Python	1.2 oz						
Bicep II	1.8 qt	PRE	3	90	100	78	219
+ Python	1.2 oz						
LSD(.05)			20	9	8	18	61

[1] Crop injury rated - 5/22/97; DAT = days after treatment application.
[2] Lgcg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower (rated on 6/9/97).

Table 3. Weed control, corn injury, and grain yield with early postemergent herbicides, Rossville, KS, 1997.

Treatment[1]	Rate	Appl Time[2]	Corn Inj. 14DAT	Weed Control, 14 DAT[3] Lgcg	Paam	Cosf	Colq	Grain Yield
	prod./a		%	%				bu/a
Untreated check	---	---	0	0	0	0	0	17
Dual II + Action + COC	1.5 pt 1.2 oz 2.0 pt	PRE EP EP	0	95	97	47	20	107
Dual II + Action + COC	1.5 pt 1.5 oz 2.0 pt	PRE EP EP	2	95	100	43	67	83
Action + Clarity + COC	1.2 oz 8.0 oz 2.0 pt	EP EP EP	0	83	100	100	98	161
Dual II + Exceed + COC	1.5 pt 1.0 oz 2.0 pt	PRE EP EP	2	87	92	100	85	172
Bicep Lite II + Exceed + COC	2.4 qt 1.0 oz 2.0 pt	PRE EP EP	0	88	100	100	100	175
Dual II + Exceed + Tough + COC	1.5 pt 0.8 oz 1.0 pt 2.0 pt	PRE EP EP EP	0	90	97	100	90	172
Dual II + Exceed + Action + COC	1.5 pt 0.8 oz 1.2 oz 2.0 pt	PRE EP EP EP	0	78	98	100	100	137
Dual II + Exceed + Clarity + NIS	1.5 pt 0.8 oz 6.0 oz 0.25 %	PRE EP EP EP	3	83	100	100	80	161
TopNotch +Buctril/Atrazine	2.0 qt 1.0 qt	PRE EP	0	95	100	100	100	168
Basis Gold + COC + UAN	14.0 oz 1%+2.0 qt	EP EP	0	85	100	63	97	119
Hornet + Basis Gold + UAN + NIS	2.8 oz 14.0 oz 2.5+.25%	EP EP EP	3	80	97	100	97	163

(Continued)

Table 3. Weed control, corn injury, and grain yield with early postemergent herbicides, Rossville, KS, 1997.

Treatment[1]	Rate	Appl Time[2]	Corn Inj. 14DAT	Weed Control, 14 DAT [3] Lgcg	Paam	Cosf	Colq	Grain Yield
	prod./a		%	%				bu/a
Dual II	2 pt	PRE	2	82	100	100	100	155
+ Hornet	1.87 oz	EP						
+ Atrazine 90DF	1.11 lb	EP						
+ UAN + NIS	2.5+.25%	EP						
Dual II	2 pt	PRE	0	83	98	98	83	146
+ Hornet	2.8 oz	EP						
+ Banvel	0.5 pt	EP						
+ UAN + NIS	2.5+.25%	EP						
Dual II	2.05 pt	PRE	0	82	98	100	100	154
+ Scorpion III	0.25 lb	EP						
+ UAN + NIS	2.5+.25%	EP						
Dual II	2.05 pt	PRE	0	92	100	100	100	175
+ Scorpion III	0.25 lb	EP						
+ Atrazine 90DF	1.11 lb	EP						
+ UAN + NIS	2.5+.25%	EP						
Scorpion III	2.05 pt	EP	0	43	97	100	100	120
+ Accent	0.25 lb	EP						
+ UAN + NIS	2.5+.25%	EP						
Prowl	3.0 pt	EP	2	73	100	97	100	139
+ Contour	1.3 pt	EP						
+ COC + UAN	1 qt+1 qt	EP						
Prowl	3.0 pt	EP	0	58	100	97	100	127
+ Resolve	5.3 oz	EP						
+ NIS + UAN	1 qt+1 qt	EP						
Prowl	3.0 pt	EP	0	77	97	100	100	125
+ Lightning	1.28 oz	EP						
+ COC + UAN	1 qt+1 qt	EP						
Atrazine	1.5 lb	EP	0	83	95	97	100	127
+ Lightning	1.28 oz	EP						
+ COC + UAN	1 qt+1 qt	EP						
Banvel	6.0 oz	EP	0	80	100	100	100	146
+ Lightning	1.28 oz	EP						
+ COC + UAN	1 qt+1 qt	EP						
Prowl	3.0 pt	EP	0	52	100	93	100	115
+ Atrazine	1.5 lb	EP						
+ COC	1.0 qt	EP						
LSD(.05)			NS	18	12	25	36	40

[1] COC = crop oil concentrate; UAN = 28-0-0 fertilizer; NIS = nonionic surfactant.
[2] PRE = preemergence; EP = early postemergence.
[3] Lgcg = large crabgrass; Paam = Palmer amaranth; Cosf = common sunflower; Colq = common lambsquarter; DAT = days after treatment application; Injury and weed control rated on 6/19/97.

SOYBEAN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux

Summary

Eight and twenty-five herbicide treatments were evaluated in a preplant incorporated and preemergence (PPI/PRE) test and an early and late post emergence (EP/LP) test, respectively. PPI and PRE treatments caused very little injuury, but most EP and LP treatments caused some injury. Treatments including Cobra, Pursuit, Raptor, or Status gave the most injury, and Roundup Ultra gave the least. PPI treatments gave better control of Paam than PRE treatments. One treatment of Roundup Ultra did not give satisfactory weed control. Untreated checks had yields of only 12 and 21 bu/a.

Introduction

Chemical weed control and cultivation have been used commonly to control weeds in row crops. Weeds can seriously depress soybean yields. Two soybean herbicide tests were conducted, the PPI/PRE included preplant, incorporated and preemergence herbicides and the EP/LP test included early and late postemergence herbicides on Roundup-resistant soybeans. The major weeds evaluated in these tests were large crabgrass, Palmer amaranth, common sunflower, and eastern black nightshade.

Procedures

Both tests were conducted on a Sarpy fine sandy loam soil with a pH of 7.3 and organic matter content of 1.7 percent previously cropped to corn. DynaGrow 3378N (PPI/PRE test) and Asgrow 3601 (EP/LP test) soybeans were planted on May 9 at 144,000 seeds per acre in 30-inch rows. Fertilizer (10-34-0) was banded at 120 lbs/a at planting. The herbicides were applied as follows: PPI - May 9; PRE - May 10; EP - June 10; LP - July 9. Significant rainfalls after the PPI and PRE treatments were on May 17 (0.15 inch), May 19 (0.23 inch), and May 25 (1.25 inch). The plots were not cultivated. Ratings reported for crop injury were made on June 6 for the PPI/PRE test and on June 17 and June 24 for the EP/LP test. Ratings reported for weed control were made on June 21 for the PPI/PRE test and on July 17 for the EP/LP test. Some plots were not harvested because of high infestations of sunflower; other plots were harvested on October 14 (PPI/PRE test) and October 7 (EP/LP test) using a modified Gleaner E plot combine.

Results

Very little injury was observed with the PPI or PRE treatments (Table 4). Large crabgrass and Palmer amaranth control was much better with the PPI treatments than with the PRE treatments because of the lack of rainfall to activate the PRE treatments. Control of common sunflower and eastern black nightshade was excellent with all treatments. Yields were related closely to weed control; the untreated check yielded only 12 bu/a.

Most postemergence treatments had some injury (Table 5). Pursuit + Cobra gave the most injury, followed by treatments containing Pursuit, Pursuit + Status, or Raptor + Status. The least amount of injury was observed with Roundup Ultra. All treatments gave excellent control of common sunflower, indicating that none are ALS resistant. One treatment of Roundup Ultra of either 1.5 or 2.0 pt/a did not give satisfactory control of large crabgrass. The LP treatment of Roundup Ultra probably would have given better weed control if applied a week earlier. The soybean canopy was starting to form and probably shielded some of the crabgrass and Palmer amaranth from herbicide coverage. Soybean yields were generally related closely to weed control, ranging from 32.1 to 58.1 bu/a; the untreated check yielded only 21.1 bu/a.

Table 4. Weed control, soybean injury, and grain yield with preemergence and preplant incorporated herbicides, Kansas River Valley Experiment Field, Rossville, KS, 1997.

Treatment	Rate	Appl Time	Soybean Inj. 28 DAT	Weed Control, 42 DAT[1] Lgcg	Paam	Cosf	Ebns	Grain Yield
	prod./a		%		%			bu/a
Untreated check	---	---	0	0	0	0	0	12
Treflan + F irstRate	1.0 qt 0.6 oz	PPI PPI	0	92	97	100	95	42
Treflan + FirstRate	1.0 qt 0.75 oz	PPI PPI	0	92	93	100	98	44
Treflan + FirstRate + Authority	1.0 qt 0.6 oz 4.25 oz	PPI PPI PPI	0	90	98	100	97	40
Prowl + FirstRate	3.0 pt 0.6 oz	PRE PRE	3	68	75	98	100	24
Prowl + FirstRate	3.0 pt 0.75 oz	PRE PRE	7	77	82	100	100	30
Prowl + Pursuit	1.5 qt 1.44 oz	PRE PRE	7	82	82	100	100	35
Dual II + Authority + Classic	1.5 pt 4.25 oz 2.5 oz	PRE PRE PRE	0	62	78	95	100	22
Authority + FirstRate + Command	4.25 oz 0.6 oz 2.0 pt	PRE PRE PRE	0	65	75	100	100	31
LSD(.05)			3	28	34	31	30	24

[1] Lgcg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower; Ebns = eastern black nightshade; DAT = days after treatment application.

Table 5. Weed control, soybean injury, and grain yield with early and late postemergent herbicides, Kansas River Valley Experiment Field, Rossville, KS, 1997.

Treatment[2]	Rate	Appl Time	Soybean Injury 7DAT	14DAT	Weed Control, 28 DAT[1] Lgcg	Paam	Cosf	Grain Yield
	prod./a		%			%		bu/a
Untreated Check		---	0	0	0	0	0	21.1
Squadron	3.0 pt	PPI	0	0	85	95	100	47.5
Tri-Scept	2.33 pt	PPI	3	2	87	95	100	47.1
Steel	3.0 pt	PPI	8	3	92	88	100	42.5

Table 5. Weed control, soybean injury, and grain yield with early and late postemergent herbicides, Kansas River Valley Experiment Field, Rossville, KS, 1997.

Treatment[2]	Rate	Appl Time	Soybean Injury 7DAT	Soybean Injury 14DAT	Weed Control, 28 DAT[1] Lgcg	Weed Control, 28 DAT[1] Paam	Weed Control, 28 DAT[1] Cosf	Grain Yield
	prod./a		%			%		bu/a
Detail	1.0 qt	PRE	15	3	100	100	100	45.2
Prowl	3.0 pt	PRE	12	2	93	77	100	48.1
+ Pursuit	1.44 oz	EP						
+ COC + UAN	2 pt + 2.5 pt	EP						
Prowl	3.0 pt	PRE	10	3	93	73	100	32.1
+ Pursuit	1.44 oz	EP						
+ Pinnacle	0.063 oz	EP						
+ COC + UAN	2 pt + 2.5 pt	EP						
Prowl	3.0 pt	PRE	23	10	90	90	100	39.6
+ Pursuit	1.44 oz	EP						
+ Cobra	6.0 oz	EP						
+ COC + UAN	2 pt + 2.5 pt	EP						
Prowl	2.4 pt	PPI	12	3	83	93	100	42.9
+ Pursuit	1.44 oz	EP						
+ Status	8.0 oz	EP						
+ NIS + UAN	0.25% + 1 qt	EP						
Prowl	2.4 pt	PRE	13	5	92	100	100	54.5
+ Raptor	4.0 oz	EP						
+ Status	8.0 oz	EP						
+ NIS + UAN	0.25% + 1 qt	EP						
Canopy XL	6.8 oz	PRE	3	0	75	97	98	53.1
+ Assure	8.0 oz	EP						
COC	1.0%	EP						
Canopy XL	7.9 oz	PRE	3	0	83	95	100	56.8
+ Assure	8.0 oz	EP						
+ COC	1.0%	EP						
Roundup Ultra	1.5 pt	EP	2	0	68	87	100	44.5
Roundup Ultra	2.0 pt	EP	3	0	70	82	100	51.5
Roundup Ultra	1.0 pt	EP	2	0	65	77	95	34.4
+ Roundup Ultra	1.0 pt	LP						
Canopy XL	3.6 oz	PRE	0	0	72	92	100	50.1
+ Roundup Ultra	1.0 pt	EP						
+ NIS	0.25%	EP						

(Continued)

Table 5. Weed control, soybean injury, and grain yield with early and late postemergent herbicides, Kansas River Valley Experiment Field, Rossville, KS, 1997.

Treatment[2]	Rate	Appl Time	Soybean Injury 7DAT	Soybean Injury 14DAT	Weed Control, 28 DAT[1] Lgcg	Weed Control, 28 DAT[1] Paam	Weed Control, 28 DAT[1] Cosf	Grain Yield
	prod./a		%			%		bu/a
Canopy XL	3.6 oz	PRE	2	0	68	93	100	58.1
+ Roundup Ultra	1.0 pt	EP						
+ Synchrony STS	0.5 oz	EP						
+ NIS	0.25%	EP						
FirstRate	0.3 oz	EP	0	0	78	90	100	44.5
+ Roundup Ultra	1.12 pt	EP						
FirstRate	0.6 oz	PRE	3	0	88	97	100	56.9
+ Roundup Ultra	1.12 pt	LP						
Treflan HFP	1.0 qt	PPI	8	3	93	100	100	57.1
+ Roundup Ultra	1.12 pt	LP						
Expert	1.5 oz	EP	8	0	87	77	100	40.6
+ Roundup Ultra	0.75 pt	EP						
+ NIS	0.25%	EP						
Expert	0.5 oz	EP	2	0	88	90	100	52.4
+ Roundup Ultra	0.75 pt	EP						
+ NIS + AMS	.25%+2.5 lb	EP						
Prowl	2.4 pt	PPI	2	0	83	87	100	46.9
+ Roundup Ultra	1.0 pt	EP						
Squadron	3.0 pt	PPI	3	0	90	93	100	53.5
+ Roundup Ultra	1.0 pt	EP						
Prowl	2.4 pt	PPI	7	0	98	98	100	49.3
+ Pursuit	1.44 oz	EP						
+ Roundup Ultra	1.0 pt	EP						
+ AMS	2.5 lb	EP						
Authority	4.3 oz	PRE	2	0	83	100	100	55.8
+ Roundup Ultra	1.0 pt	EP						
LSD(.05)			7	4	20	21	3	21.6

[1] Lgcg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower; Ebns = eastern black nightshade; DAT = days after treatment application; Injury ratings - 6/17/97 & 6/24/97; Weed control rating - 7/17/97.
[2] COC = crop oil concentrate; UAN = 28-0-0 fertilizer; NIS = nonionic surfactant.

WHITE FOOD-CORN PERFORMANCE TEST

Larry D. Maddux

Summary

The average yield of the 43 hybrids in the test was 182 bu/a, with a range from 143 to 211 bu/a. The LSD(.05) was 21 bu/a (two hybrids must differ in yield by 21 bu/a to be considered significantly different in yielding ability 95% of the time).

Introduction

This test is one of the 13 locations of a regional fee test coordinated by Dr. L. L. Darrah with USDA-ARS at the University of Missouri. The 1997 test included 39 white hybrids, one white hybrid check, and three yellow hybrid checks submitted by 13 commercial seed producers. Fourteen white hybrids were new to the test in 1997.

Procedures

Anhydrous ammonia at 150 lbs N/a was applied on March 26. Harness Xtra 5.6L at 2.2 qt/a was incorporated with a field cultivator on April 21. The hybrids were planted on April 23 at 32,000 seeds/a in 30-inch rows on a silt loam soil following a previous crop of soybeans. Fertilizer (10-34-0) at 120 lb/a was banded at planting. The test was furrowed for irrigation on June 5 and harvested on October 2 with a Gleaner E plot combine.

Results

Yields in this test averaged182 bu/a, with a range from 143 to 211 bu/a and an LSD(.05) of 21 bu/a (Table 6). Irrigated corn yields were good this year. The yellow corn performance test (conducted at the Paramore Unit) had an average yield of 199 bu/a with a range from 163 to 229 bu/a. The white corn check (K55xCI66)FR802 yielded 143 bu/a, and the three yellow checks (B73xMo17 Pioneer Brand 3245 and 3394) all yielded 189 bu/a.

Table 6. Grain yield, stand, root and stalk lodging, ear height, moisture content, and days from planting to half-silk of the white food-corn hybrids, Kansas River Valley Experiment Field, Topeka, KS, 1997.

Brand	Hybrid	Yield	Stand	Root Lodged	Stalk Lodged	Half Silk	Moisture
		bu/a	%	%	%	days	%
Asgrow	RX921W	177	101	0.0	0.0	82	20.3
DeKalb Genetics	DK703W	183	100	0.0	0.6	80	17.8
DeKalb Genetics	EXP764W	160	101	0.0	0.0	81	18.0
DeKalb Genetics	EXP764WB	199	102	0.0	0.4	80	17.6
DeKalb Genetics	EXP766W	158	97	0.0	0.9	79	16.6
Diener	DB 115W	166	100	0.0	0.5	80	21.5
Garst	8320W	183	98	0.0	0.0	80	17.1
Garst	8490W	191	94	0.0	0.5	79	17.0
Hoegemeyer	1125W	169	101	0.0	0.0	82	17.8
IFSI	90-1	176	97	0.0	0.0	79	17.1

(Continued)

Table 6. Grain yield, stand, root and stalk lodging, ear height, moisture content, and days from planting to half-silk of the white food-corn hybrids, Kansas River Valley Experiment Field, Topeka, KS, 1997.

Brand	Hybrid	Yield	Stand	Root Lodged	Stalk Lodged	Half Silk	Mois-ture
		bu/a	%	%	%	days	%
IFSI	94-3	193	101	0.0	0.4	79	21.8
IFSI	95-1	182	103	0.0	0.8	80	19.8
IFSI	97-1	185	99	0.0	0.0	81	21.1
LG Seeds	NB749W	160	102	0.0	0.0	80	15.8
Pioneer Brand	32H39	199	104	0.0	0.0	79	17.9
Pioneer Brand	3203W	182	100	0.0	0.9	81	18.6
Pioneer Brand	3287W	172	104	0.0	0.0	78	17.9
Pioneer Brand	X1156MW	201	99	0.0	0.0	79	17.0
Pioneer Brand	X1186KW	200	97	0.0	0.0	78	18.3
Pioneer Brand	X1186MW	187	104	0.0	0.0	80	18.9
Sturdy Grow	SG765W	188	103	0.0	0.0	78	16.8
Sturdy Grow	SG777W	167	94	0.0	1.0	81	16.5
Sturdy Grow	SG797W	170	96	0.0	0.0	80	18.6
Vineyard	V442W	160	102	0.0	0.0	80	19.9
Vineyard	V448W	183	106	0.0	0.0	79	17.5
Vineyard	V449W	164	101	0.0	0.0	80	22.9
Vineyard	V453W	200	102	0.0	0.5	82	20.6
Vineyard	Vx4596	173	100	0.0	0.0	82	19.3
Whisnand	50AW	196	96	0.0	0.0	83	20.8
Whisnand	51AW	193	99	0.0	0.0	83	21.8
Whisnand	92AW	167	101	0.0	0.0	80	22.9
Wilson	1789	194	102	0.0	0.5	82	20.6
Wilson	E5003	187	100	0.0	0.0	82	19.3
Wilson	E9352	191	96	0.0	0.0	83	20.8
Wilson	E9360	183	99	0.0	0.0	83	21.8
Zimmerman	Z62W	183	94	0.0	0.0	80	16.8
Zimmerman	Z64W	211	103	0.0	0.4	81	20.0
Zimmerman	Z72W	188	99	0.0	0.0	82	18.1
Zimmerman	Z73W	184	100	0.0	1.8	82	17.3
White check	(K55xCI66)FR8	143	91	0.0	2.2	84	24.2
	02W	190	99	0.0	0.0	81	16.1
Yellow check	B73xMo17	189	99	0.0	0.4	81	17.7
Yellow check	Pioneer Brand 3245	189	104	0.0	0.9	78	15.3
Yellow check	Pioneer Brand 3394						
Mean		182	100	0.0	0.3	80	18.6
LSD 0.05		21	NS	NS	NS	2	2.4
CV%		7				2	8.0

PERFORMANCE OF HIGH-OIL CORN HYBRIDS

Scott A. Staggenborg and Larry D. Maddux

Summary

A study was conducted to assess the performance of nine high-oil corn hybrids and their normal counterparts under irrigation. Grain yields ranged from 160 to 206 bu/a for the high-oil hybrids, which had oil contents ranging from 5.8 to 7.3%. These hybrids also produced higher levels of lysine, protein, and energy. Normal corn yields ranged from 158 to 209 bu/a. On average, the high-oil corn hybrids produced grain yields within 5% of yields of the conventional hybrids, while producing higher levels of oil, lysine, protein and energy.

Introduction

Interest in performance of high-oil corn has increased in northeast Kansas. Dupont Optimum Quality Grains estimated that approximately 1 million acres of high-oil corn were produced in the U.S. in 1997, with approximately 70% being used as livestock feed and the remainder for cash sales. Because of isolation requirements and small market areas, these hybrids are not entered routinely into university performance trials. The objectives of this study were to evaluate the performance of several high-oil corn hybrids and compare them to their non-high- oil counterparts.

Procedures

Nine high-oil corn hybrids were evaluated in 1997 at the Rossville Unit of the Kansas River Valley Experiment Field (Table 7). All hybrids utilized “Top Cross” pollinators to achieve elevated oil levels. For each high-oil hybrid used, its normal yellow corn counterpart also was included. A 50-foot isolation was utilized between the non-high-oil hybrid block and each high-oil hybrid group of the same pollinator. All plots were planted on April 24, 1997. Irrigations of approximately 1 acre/inch were applied on July 11, 19, 26 and August 9 and 15. All plots were harvested on September 12, 1997.

Statistical analysis of these hybrids posed a problem in that isolation groups have a set of unique treatments. Variances were compared between each high-oil hybrid group. Because variances were different, the high-oil corn hybrids were analyzed within each company only. The normal corn hybrids also were analyzed as a complete group in a randomized block design.

Results

Grain yields were excellent considering the hot-dry period that occurred during late June and early July. High-oil corn yields ranged from 160.4 to 206.7 bu/a (Table 7). Grain yields for the conventional corn counterparts followed a similar pattern, with yields ranging from 158.0 to 209.5 bu/a (Table 8). Previous research with high-oil corn at other universities and at Kansas State indicated an 8 to 15% yield decline for high- oil corn versus conventional yellow corn. These results indicate a difference of approximately 10 bu/a or 5%, suggesting that the high-oil corn hybrids may be improving in their abilities to produce yield as well as increased oil contents. In the case of two hybrid combinations, the high-oil hybrid had yields that were numerically greater than those of their conventional counterparts, with the differences being 2 and 6%.

These results also indicate that differences occurred among the high-oil hybrids as well as between the high-oil and conventional hybrids concerning many of the grain quality components measured. In the high-oil hybrids, oil contents ranged from 5.8 to 7.3 percent. Oil contents of the high-oil hybrids were approximately 2.5 percentage points higher than those of conventional hybrids. Lysine levels ranged from 0.28 to 0.30 in the high-oil hybrids. These levels were 0.027 percentage points higher than the lysine levels of the conventional corn hybrids. The high-oil hybrids were 0.037 percentage points higher in protein and 71 Mcal/a higher in energy than their conventional counterparts.

Conclusions

As in previous research, high-oil corn hybrids showed the ability to produce excellent grain yields. The results of this year's study indicate that the yield potentials of high-oil corn are increasing. The difference between the high-oil and conventional corn hybrids was approximately 5%, a two- to threefold decrease compared to previous results.

Table 7. Yield, oil content, lysine, energy, protein and test weight for nine high-oil corn hybrids, Kansas River Valley Experiment Field, Rossville, 1997.

Hybrid	Yield (bu/a)	Oil (%)	Lysine (%)	Energy (Mcal/a)	Protein (%)	Oil Premium ($/bu)
Pfister 2650-H	186.4	6.6	0.28	16702	7.8	0.16
Pfister 2652-H	193.4	7.3	0.28	17464	8.0	0.23
Pfister 2680-H	191.5	7.0	0.28	17282	7.7	0.20
$LSD_{(0.05)}$	NS	0.6	NS	NS	NS	0.06
N6423TC	160.4	6.6	0.28	14258	7.6	0.16
N7316	200.2	6.4	0.29	17893	8.2	0.14
NK7577	206.8	6.8	0.29	18494	8.2	0.17
$LSD_{(0.05)}$	NS	NS	NS	NS	NS	NS
H-641	161.2	5.8	0.30	14442	9.1	0.04
H-655	160.6	5.8	0.29	14344	8.6	0.04
H-666	173.1	5.9	0.29	15367	8.5	0.04
$LSD_{(0.05)}$	NS	NS	NS	NS	NS	NS

Table 8. Yield for nine non-high-oil corn hybrids and the yield difference between each hybrid and its high-oil counterpart, Kansas River Valley Experiment Field, Rossville, 1997.

Hybrid	Yield (bu/a)	Yield Difference (bu/a)	Oil (%)	Lysine (%)	Energy (Mcal/a)	Protein (%)
Pfister 2650	209.5	11.5	3.8	0.25	17971	8.0
Pfister 2652	204.8	5.7	4.2	0.25	17568	7.7
Pfister 2680	186.8	-2.4	3.9	0.25	15914	7.7
N6420	195.4	34.9	4.0	0.25	16715	8.0
N7333BT	196.5	-3.7	3.8	0.27	16738	8.8
NK7590BT	194.9	-12.0	4.0	0.26	16601	8.3
H-2641	158.0	-3.2	4.0	0.27	13545	8.7
H-2655	181.2	20.6	3.8	0.26	15529	8.7
H-2666	192.4	19.3	4.0	0.26	16456	8.3
$LSD_{(0.05)}$	24.6	- - -	NS	0.01	2076	0.4

EFFECTS OF APPLICATION METHOD, TIME, AND RATE OF SUPPLEMENTAL NITROGEN ON IRRIGATED SOYBEANS

Larry D. Maddux

Summary

A study was initiated in 1996 to evaluate effects of nitrogen (N) application time and rate on irrigated soybeans. Soybean yields for the 0 N control plot were 71.8 bu/a in 1996 and 65.7 bu/a in 1997. Fertigation at the R1 and R3 growth stages resulted in yields of 73.7 and 73.8 bu/a in 1996, but this slight yield increase was not statistically significant. Fertigation at R5 resulted in no significant yield difference. No significant difference in yield was observed in 1997 with any treatment. Leaf N content at R6 and 1996 oil contents in seed were not affected by the treatments. This study will be continued in 1998.

Introduction

Irrigated soybean yields in the Kansas River Valley commonly exceed 60 bu/a. Nitrogen (N) demand during grain fill is quite high at these yield levels. Based on research conducted using broadcast N fertilizer, some producers have been applying about 30 lbs/a supplemental N to soybean fields through irrigation systems at the R3 stage of growth. This research was designed to determine the optimum N rate and time of N application to provide maximum economic soybean yields.

Procedures

A sprinkler-irrigated site on a Eudora silt loam soil at the Paramore Unit was used. Nitrogen rates included 0, 30, and 60 lbs N/a, and UAN was applied as a fertigation treatment at R1, R3 (beginning pod), and R5 (beginning seed). The treatments were arranged in a randomized complete block design with four replications. A minimum of 0.5 inches of water was applied to all plots with each fertigation treatment. Leaf samples were taken at approximately R6 (pod fill). Grain yields were determined by machine harvesting, and seed weights were determined.

Results

No significant differences in soybean yields because of N application time or N rate occurred in either year as shown in Table 9. However, in 1996, we observed a slight trend for increased yields with fertigation treatments at the R1 and R3 growth stages. Nitrogen application time or N rates also had no effects on leaf N content at R6 in either year or the oil content of seed in 1996. This research will be continued next year.

Table 9. Effects of nitrogen application times and rates on leaf N, oil content, and yield of irrigated soybean, Kansas River Valley Experiment Field, Topeka, KS.

		Oil	R6 Leaf N		Yield	
N Application Time	N Rate	1996	1996	1997	1996	1997
	lbs/a	%	%		bu/a	
None	0	22.5	5.66	3.39	71.8	65.7
UAN, Fertigation, R1	30	22.2	5.28	3.56	73.9	60.6
UAN, Fertigation, R1	60	22.3	5.56	3.53	73.5	61.8
UAN, Fertigation, R3	30	22.2	5.28	3.67	72.4	63..3
UAN, Fertigation, R3	60	22.0	5.53	3.59	75.1	67.1
UAN, Fertigation, R5	30	21.9	5.54	3.50	74.0	65.6
UAN, Fertigation, R5	60	21.8	5.54	3.64	69.3	60.5
LSD(.05)		NS	NS	NS	NS	NS
N Application Time Means						
UAN, Fertigation, R1		22.3	5.42	3.54	73.7	61.2
UAN, Fertigation, R3		22.1	5.41	3.63	73.8	65.2
UAN, Fertigation, R5		21.9	5.54	3.56	71.6	63.1
LSD(.05)		NS	NS	NS	NS	NS
N Rate Means						
	30	22.2	5.40	3.57	72.9	63.1
	60	22.1	5.48	3.54	71.5	63.6
LSD(.O5)		NS	NS	NS	NS	NS

MACRONUTRIENT FERTILIZATION FOR IRRIGATED CORN FOLLOWING SOYBEANS

Larry D. Maddux

Summary

A corn-soybean cropping sequence was evaluated from 1983 through 1996 (7 years of corn; 7 years of soybeans) for the effects of N, P, and K fertilization on the corn crop. The 7-year average showed corn yield increases with increasing N rates up to 160 lbs N/a. Previously applied N at 160 lbs/a also resulted in an average soybean yield increase of 3.1 bu/a. Corn and soybeans both showed yield responses to P, but only soybean had significant 7-year average yield increases (3.3 and 4.5 bu/a for 30 and 60 lbs P_2O_5/a). Potassium fertilization increased average corn and soybean yields by 6 and 2.3 bu/a. Nitrogen increased V6 N content and yield of corn in 1997. No significant response to residual soil P was obtained, probably because of the almost 41 lbs P_2O_5/a applied in the starter to all plots. Plant K content at V6 was increased with K fertilization, but no yield response was obtained.

Introduction

A study was initiated in 1972 at the Paramore Unit to evaluate the effects of nitrogen (N), phosphorus (P), and potassium (K) on irrigated soybeans. The study was changed to a corn and soybean cropping sequence and planted to corn in 1983. The objectives of the study are to evaluate the effects of applications of N, P, and K made to a corn crop on (a) grain yields of corn and the following soybean crop and (2) soil test values.

Procedures

The initial soil test in March, 1972 on this silt loam soil was 47 lbs/a of available P and 312 lbs/a of exchangeable K in the top 6 in. of the soil profile. Rates of P were 50 and 100 lbs P_2O_5/a from 1971 - 1975 and 30 and 60 lbs P_2O_5/a from 1976 - 1995. In 1997, the broadcast rates of P were dropped, and a starter of 120 lbs/a of 10-34-0 (12 lbs N/a + 41 lbs P_2O_5/a) was applied to all plots. Rates of K were 100 lbs K_2O/a from 1971 to 1975, 60 lbs K_2O/a from 1976 to 1995, and 150 lbs K_2O/a in 1997. Rates of N included a factorial arrangement of 0, 40, and 160 lbs N/a (with single treatments of 80 and 240 lbs N/a). The 40 lbs/a N rate was changed to 120 lbs N/a. N, P, and K treatments were applied every year to soybeans from 1971 to 1982 and every other year (odd years) to corn from 1983 to 1995.

Corn hybrids planted were BoJac 603 - 1983; Pioneer 3377 - 1985, 1987, 1989; Jacques 7820 - 1991 and 1993, Mycogen 7250CB - 1995; and DeKalb 626 - 1997. Soybeans planted were Douglas - 1984; Sherman - 1986, 1988, 1990, 1992, and 1996; and Edison - 1994. Corn was planted in mid-April, and soybeans were planted in early to mid-May. Herbicides were applied preplant, incorporated each year. The plots were cultivated, furrowed, and furrow irrigated as needed. Whole-plant samples were taken at the 6-leaf stage of growth (V6). A Gleaner E plot combine was used for harvest.

Results

Average corn and soybean yields for the 14-year period from 1983 through 1996 (7-year averages) are shown in Table 10. The 7-year average corn yield showed no significant response to P fertilization, although significant responses were obtained in 1985 and 1993. An average increase of 6 bu/a (significant at the 6% level of probability) was obtained over the 7 years for 60 lbs/a of applied K_2O. Previously applied N of 160 lbs/a resulted in an average increase of 3.1 bu/a in soybean yield. Soybeans responded to P fertilization with average yield increases of 3.3 and 4.5 bu/a with 30 and 60 lbs P_2O_5/a. Potassium fertilization of soybeans resulted in an average yield increase of 2.3 bu/a.

In 1997, V6 N content of corn increased with N up to the 172 lbs/a rate following the previous soybean crop of approximately 70 bu/a (Table 11). However, corn yields of 194 bu/a were obtained for both the 132 and 172 lbs N/a treatments. Corn yield obtained with starter fertilizer only (12 lbs N/a) was only 92 bu/a. No significant yield differences occurred in residual P, probably because of the almost 41 lbs P_2O_5/a applied in the starter to all plots. However, P content tended to increase in the V6 plant tissue with increasing rates of previously applied P (increasing soil P levels). Plant K content at V6 increased when K fertilizer was applied in 1997, but no yield response was observed. A P x K interaction occurred. Higher yields generally were obtained when both P and K were applied than when only one was applied. The one exception was the 132-60-0 vs 132-60-150 treatments. These results indicate the importance of soil testing and maintaining a balanced fertility program.

Table 10. Effects of nitrogen, phosphorus, and potassium applications on corn and soybean yields in a corn-soybean cropping sequence, Kansas River Valley Experiment Field, Topeka[1].

Fertilizer Applied			7-Year Average Yield	
N	P_2O_5	K_2O	Corn	Soybean
	lbs/a		bu/a	bu/a
0	0	0	87	63.9
0	0	60	86	65.6
0	30	0	93	69.0
0	30	60	86	69.8
0	60	0	84	69.6
0	60	60	92	72.3
40	0	0	129	66.3
40	0	60	126	67.7
40	30	0	123	66.7
40	30	60	138	72.8
40	60	0	124	70.9
40	60	60	132	71.4

(Continued)

Table 10. Effects of nitrogen, phosphorus, and potassium applications on corn and soybean yields in a corn-soybean cropping sequence, Kansas River Valley Experiment Field, Topeka[1].

Fertilizer Applied			7-Year Average Yield	
N	P_2O_5	K_2O	Corn	Soybean
	lbs/a		bu/a	bu/a
160	0	0	171	68.8
160	0	60	177	70.0
160	30	0	168	70.5
160	30	60	181	73.8
160	60	0	167	71.3
160	60	60	178	74.2
80	30	60	151	71.5
240	30	60	182	71.7
LSD(.05)			17	5.1
Nitrogen Means				
0			88	68.4
40			129	69.3
160			174	71.5
LSD(.05)			7	2.5
Phosphorus Means				
	0		129	67.1
	30		131	70.4
	60		129	71.6
LSD(.05)			NS	4.5
Potassium Means				
		0	127	68.6
		60	133	70.9
LSD(.05)			NS[2]	2.5

[1] Fertilizer applied to corn in 1983, 1985, 1987, 1989, 1991, 1993, and 1995 and to soybeans for 11 years prior to 1983.
[2] Significant at the 6% level of probability.

Table 11. Effects of nitrogen, phosphorus, and potassium applications on plant N, P, K and yield of corn in a corn-soybean cropping sequence, Kansas River Valley Experiment Field, 1997, Topeka[1].

Fertilizer Applied			V6 Plant Nutrient Content			Corn Yield
N	P_2O_5[2]	K_2O	N	P	K	
	lbs/a		%	%	%	bu/a
0	0	0	3.36	0.446	3.24	93
0	0	150	3.59	0.448	3.95	95
0	30	0	3.35	0.508	2.87	101
0	30	150	3.72	0.528	4.24	87
0	60	0	3.52	0.522	3.25	86
0	60	150	3.85	0.505	4.48	89
120	0	0	4.21	0.486	3.41	200
120	0	150	4.15	0.486	4.01	181
120	30	0	4.07	0.468	3.35	189
120	30	150	4.20	0.466	3.75	208
120	60	0	4.37	0.498	3.40	195
120	60	150	4.15	0.519	3.92	190
160	0	0	4.38	0.483	3.45	203
160	0	150	4.24	0.472	3.79	177
160	30	0	4.38	0.497	3.07	184
160	30	150	4.24	0.435	3.84	205
160	60	0	4.45	0.483	3.11	191
160	60	150	4.11	0.507	3.84	204
80	30	150	4.31	.490	4.39	187
240	30	150	4.18	.445	3.86	206
LSD(.05)			0.44	NS	0.60	27
<u>Nitrogen Means</u>						
0			3.56	0.499	3.67	92
120			4.19	0.484	3.64	194
160			4.30	0.479	3.52	194
LSD(.05)			NS	NS	NS	19
<u>Phosphorus Means</u>						
	0		3.99	0.474	3.64	158
	30		3.99	0.484	3.52	162
	60		4.07	0.506	3.67	159
LSD(.05)			NS	NS	NS	NS
<u>Potassium Means</u>						
		0	4.01	0.488	3.24	160
		150	4.03	0.487	3.98	159
LSD(.05)			NS	NS	0.37	NS

[1] Fertilizer applied to corn in 1983, 1985, 1987, 1989, 1991, and 1993 and to soybeans for 11 years prior to 1983.
[2] Phosphorus was applied only in starter in 1997 to these previous P rates.

SANDYLAND EXPERIMENT FIELD

Introduction

The Sandyland Experiment Field was established in 1952 to address the problems of dryland agriculture on the sandy soils of the Great Bend Prairie of SC Kansas. In 1966, an irrigated quarter was added to demonstrate how producers might use water resources more efficiently and determine proper management practices for, and adaptability of, crops under irrigation on sandy soils.

Research at the field has help defined adapted varieties/hybrids of wheat, soybeans, alfalfa, grain sorghum, and corn. As irrigated corn, soybean, wheat, and alfalfa production grew in importance, research determined proper management strategies for irrigation, fertilizer, pest control, and related cultural practices. Presently research focuses on variety/hybrid evaluation; the evaluation of new pesticides for the area; the practicality of dryland crop rotations vs. continuous wheat; corn nitrogen fertilizer requirements; re-examining accepted cultural practices for corn and grain sorghum; and the long-term effects of cropping systems on yield, soil conditions, and residue cover. A study was initiated in 1996 to determine cultural practices that maximize the efficiency of irrigation inputs from both engineering and agronomic standpoints. Also of interest to irrigated corn producers, 1998 is the third year of a study determining the effects of narrower corn rows and plant population on corn yield.

Soil Description

Soil surface horizons range from Pratt, Carwile, and Naron loamy fine sands to Farnum, Naron, and Tabler fine sandy loams. Subsoils are much more varied, ranging from loamy fine sand to clay. These soils are productive under dryland conditions with intensive management and favorable precipitation patterns. Under irrigation, these soils are extremely productive, and high quality corn, soybean, and alfalfa are important cash crops.

1997 Weather Information

The weather pattern in 1997 was similar to that in 1996, with the exception of May, and resulted in above-normal precipitation throughout the growing season (Table 1). Precipitation from March through November was at or above average, providing excellent rainfall throughout most of the growing season. Cool conditions during May through mid-June slowed growth of corn and early-planted soybeans and grain sorghum. Wheat yields in the area were much higher than expected after freezes on April 11 (19° F), April 12 (16° F), and April 13 (24° F) severely damaged wheat plants that were well past the first joint. The cool, mild conditions from mid-April until maturity allowed for nearly ideal conditions for wheat pollination and grain development. Many area producers were able to report their largest wheat crop ever, both in terms of bu/a and total production. The lack of heat stress combined with higher than normal humidity and rainfall resulted in excellent corn and soybean yields for most producers. However, the cool, wet summer did delay corn maturation, dry-down, and harvest. Dryland corn yields for much of the area were in excess of 100 bu/a. Grain sorghum yields for much of the area were twice the long-term average of 50 to 60 bu/a. Corn and grain sorghum were harvested at much higher grain moisture than normal because of the lack of heat and high humidity during late summer and early fall.

Soil moisture was excellent for establishment of the 1998 wheat crop, although planting was delayed in some fields by excess moisture, and a late October storm and freeze slowed the emergence and growth of later-planted fields.

Total precipitation for 1997 was above normal and occurred primarily from April through October (Table 1). Total 1997 precipitation measured 31.0 inches compared to the long-term average of 25.9 inches. Unlike 1996 May precipitation was much lower than normal. As of Jan. 1, 1998, topsoil and subsoil moisture was adequate to surplus over much of the area.

Low temperatures for 1997 occurred in January, with temperatures below 0°F on 3 days . Overall, the winter of 1997 was relatively mild with little snowfall. The yearly high was 101°F, occurring on three occasions in July. During the period from May 1 to September 30, temperatures were 90°F or higher on 53 days and 100° or higher 3 days. Fifteen days in August had temperatures of 90°F or higher. The storm season was much quieter than normal, and although rainfall was abundant, little of it occurred in severe storms.

The major weather event of the 1997 growing season was the series of subfreezing temperatures occurring from April 11 to 13. As stated earlier, despite predictions, this event had little negative effect on most wheat fields because of ideal conditions from mid-April through harvest. This event had no effect on corn or soybean crops; however, it killed alfalfa top growth and delayed the first cutting in most fields.

The frost-free season lasted from April 14 until October 26, resulting in a growing season of 195 days, approximately 10 days more than the long-term average. The first hard frost occurred on October 26 and was accompanied by rain, freezing rain, and snow. The absence of a hard freeze until late October allowed soybean, corn, and sorghum crops to mature normally, resulting in excellent yields despite the cool, wet summer conditions.

Table 1. Precipitation at the Sandyland Experiment Field, St. John, KS, 1997.

Month	16-Year Average	Dryland Quarter	Irrigated Quarter
		inches	
January	0.56	0.0	0.0
February	0.9	2.5	2.6
March	2.0	0.1	0.1
April	2.6	3.0	2.9
May	3.9	1.9	2.1
June	4.1	5.1	5.4
July	2.7	3.7	4.0
August	2.9	5.3	6.2
September	2.2	2.5	2.8
October	1.9	4.0	4.4
November	1.2	0.5	0.5
December	1.1	2.6	2.2
Annual Total	25.9	31.0	33.2

CROP PERFORMANCE TESTING AND NEW PROJECTS

Victor L. Martin

During the 1997 cropping season, performance tests were conducted on dryland wheat and grain sorghum, as well as irrigated wheat, soybeans, grain sorghum, and both full- and short-season corn hybrids. Several severe wind events, coupled with a late-season freeze, rendered the dryland wheat performance test highly variable and made the results unusable. The irrigated test was fine, and data from it were reported. Information from the other crop performance tests is summarized in the respective crop performance test publications available at local county extension offices.

The alfalfa variety trial established in September, 1996 had to be abandoned because of poor stands. A new test was initiated in September 1997 with excellent emergence and fall growth. Data collection will commence in May 1998. For information concerning previous alfalfa variety tests, please contact the Sandyland Experiment Field.

Data collection will start in 1998 on a dryland rotation/tillage study involving wheat, corn, and grain sorghum. Bt corn studies are continuing, as are several fertilizer studies, both dryland and irrigated. This information can be found in the Kansas Fertilizer Research report (SRP 800) and the Southwest Research-Extension Center Field Day report (SRP 789). You also may contact the Sandyland Experiment Field.

CORN HERBICIDE EVALUATION

Victor L. Martin and Dallas E. Peterson

Introduction

Weed control is a major problem in irrigated corn production, especially when postemergence cultivation is eliminated. This problem is accentuated on sandy soils low in organic matter. Additionally, there is concern about the use of Atrazine, a common herbicide in SC Kansas and the potential for its movement into groundwater. Atrazine is one of the best, most cost-effective herbicides for season-long broadleaf control on the sandy soils of the Great Bend Prairie. Problems with Atrazine do exist, especially when corn is grown continuously, because populations of Atrazine-resistant weeds develop. This study was initiated to determine the effectiveness of alternatives to herbicide programs containing preemergence Atrazine applications on sandy soils in SC Kansas and to compare newly labeled, not yet labeled, and nonresidual compounds to more conventional programs for use in Kansas.

Procedures

A loamy fine sand (Pratt and Naron) was used for this study, which was cropped to soybeans in 1995 and corn in 1994. The entire site was tandem disked once and packed in the spring of 1996 prior to planting. Fertilization included 100 lb/a 18-46-0 and 125 lb/a N applied as urea (46-0-0) prior to spring tillage and 100 lb/a N at V-6. The corn hybrid planted was NC+ 4616, a 113 day hybrid, on April 24 at 34,000 seeds/a at a depth of 1.5 inches. No soil insecticides were used. Plots were 20 ft long and 10 ft (four 30- inch rows) wide with four replications in a randomized complete block.

A total of 20 treatments was evaluated. Preemergence (PRE) treatments were applied on April 28 and postemergence (POST) treatments on May 28, except for the Hornet treatment when corn was >8 in. high (June 6). Some treatments were cultivated with a Lilliston rolling cultivator on June 10. Treatments were applied using a tractor-mounted compressed-air sprayer at 30 psi and 20 gal/a water. Crop injury and weed pressure were monitored throughout the growing season and examined extensively immediately prior to and 2 weeks after POST treatments. Plots were irrigated as necessary from June 9 until August 29, with a total of 10.25 inches of water applied in 15 irrigations. Corn was hand-harvested in mid-October and shelled mechanically. Yields were adjusted to 15.5% moisture.

Results

Treatments are listed in order of descending yield (Table 2). No significant crop injury was noted for any treatment. As in most years, the only grass present was crabgrass. All herbicide combinations provided good to excellent crabgrass control.

The two predominant broadleaf species were puncture vine and pigweed species, predominantly Palmer amaranth, although some lambsquarter, carpet weed, and cocklebur were present. Broadleaf control was fair to excellent, with the weakest treatments involving Atrazine preemergence. The single weed species that appeared to determine yield was Palmer amaranth. As Palmer amaranth pressure increased, yields decreased.

Of the top 10 treatments (best yields), five were total postemergence, none was total preemergence, and five included postemergence Atrazine applications.

Basis and Basis Gold, new postemergence SU products for grass and weed control from DuPont, were much more effective than in 1996. Unlike Basis, Basis Gold appears quite effective without the need for a cultivation.

One of the main purposes of this study is to determine the effectiveness of herbicide programs not involving preemergence Atrazine. The weather conditions in 1997 favored the inclusion of postemergence Atrazine, which appeared to significantly increase the effectiveness of the treatment combinations, but preemergence combinations involving Atrazine were less effective.

Although total postemergence programs performed quite well in 1997, great care and management must be exercised to spray weeds at the proper growth stages. This can be a serious problem when wet conditions prevent timely application. Those programs involving some preemergence herbicide for initial control offer more flexibility, especially to control crabgrass.

This study will continue to examine weed control options for corn on sandy soil. However, after 5 years, we can safely state that effective weed control is indeed possible without high use rates of preemergence Atrazine. The difficulty is comparing cost effectiveness, but with the advent of very low use-rate SU compounds, this appears to be less of a problem than in the past.

Table 2. Corn herbicide evaluation study 1997; % weed control 4.5 and 9 weeks after planting and grain yield at 15.5% moisture, Sandyland Experiment Field.

			Grass		Broadleaf		
Treatment	Rate	Time	5/26	6/27	5/27	6/27	Yield
	product/a			% soil surface free			bu/a
1 Basis Gold	12.6 oz	POST	98	96	100	99	238
Banvel	4 oz	POST					
COC	1% V/V						
AMSULF	3.4 lb						
2 Dual II	1.0 qt	PRE	94	89	94	93	229
Hornet	0.1 lb	<8 in.					
COC	1.2%V/V						
3 Extrazine	1.33 qt	PRE	98	97	100	99	226
Basis Gold	12.6 oz	POST					
4 Dual II	1.0 qt	PRE	93	83	98	96	214
Beacon	0.38 oz	POST					
Atrazine	1.0 qt	POST					
NIS	0.25% v/v						
5 Basis Gold	12.6 oz	POST	99	98	100	99	213
Cultivation		POST					
COC	1.0% v/v						
AMSULF	3.4 lb						
6 Dual II	1.0 qt	PRE	93	85	85	71	213
Atrazine	1.0 qt	POST					
COC	1%V/V						

(Continued)

Table 2. Corn herbicide evaluation study 1997; % weed control 4.5 and 9 weeks after planting and grain yield at 15.5% moisture, Sandyland Experiment Field.

			Grass		Broadleaf		
Treatment	Rate	Time	5/26	6/27	5/27	6/27	Yield
	product/a			% soil surface free			bu/a
7 Basis	0.36 oz	POST	99	95	96	95	212
COC	1 % v/v						
AMSULF	3.4 lb/a						
Cultivation							
8 Basis	0.36 oz	POST	99	94	99	99	211
Atrazine	1.5 pt	POST					
Cultivation							
9 Dual II	1 qt	PRE	94	83	86	82	211
Scorpion	4.0 oz	POST					
COC	1.2%v/v						
10 Basis	0.36 oz	POST	97	94	97	87	206
Banvel	4 oz	POST					
Cultivation							
11 Accent	0.5 oz	POST	91	80	58	51	196
Atrazine	1 qt	POST					
COC	1%v/v						
Atrazine	3.4 lb/a						
12 Dual II	1 qt	PRE	93	88	88	80	194
Atrazine	5 pt	PRE					
13 Dual II	1.0 qt	PRE	93	79	75	61	189
Hornet	0.1 lb	POST					
COC	1.2%V/V						
14 Dual II	1.0 qt	PRE	88	73	91	89	186
Marksman	1.0 qt	POST					
15 Dual II	1.0 qt	PRE	83	69	90	86	176
Buctril	1.5 pt	POST					
16 Dual II	1 qt	PRE	91	79	74	74	173
Hornet	0.2 lb	POST					
COC	1.2% v/v	>8 in.					
17 Partner	2.5 lb	PRE	88	77	70	68	171
Atrazine	1 qt	PRE					
18 Dual II	1 qt	PRE	88	74	83	61	162
Buctril+Atrazine	1 qt	POST					
19 Dual II	1 qt	PRE	88	81	55	41	149
Atrazine	1.0 qt	PRE					
20 Check			68	59	48	38	134
LSD(0.05)[1]			5.5	NS	9.7	10.7	12.6

1 Two treatments must differ by more than the LSD to be different.

GRAIN SORGHUM HERBICIDE EVALUATION

Victor L. Martin and Dallas E. Peterson

Introduction

Next to wheat, grain sorghum is the most important dryland crop in the Great Bend Prairie region of South Central Kansas. Until the advent of seed safeners, which permitted the use of Lasso and Dual for grass control, crabgrass was the most troublesome weed in the area. Crabgrass still poses problems, especially when conditions are too dry to activate the grass herbicide or when excessive rainfall moves the herbicide below the weed germination zone. The predominant broadleaf weeds are puncture vine and pigweed, especially Palmer pigweed (amaranth) which is increasing in severity.

Most areas of the state are able to use preemergence applications of Atrazine successfully to control broadleaf weeds. The low clay and organic matter sandy soils of the Sandyland area make this practice risky, because the chance of severe crop injury and stand reduction is high.

This study was initiated to examine several weed control options on the sandy soils of the Great Bend Prairie.

Procedures

A loamy fine sand was used for this study, which was cropped to grain sorghum in 1996 and corn in 1995. The entire site was tandem disked and packed prior to planting. Site pH was 5.8 as measured during the fall of 1996, necessitating the application of 1 ton/a lime in March 1997. Phosphorus and potassium soil test levels were high. Nitrogen was applied in a split application of urea with 50 lb N/a applied preplant and 75 lb N/a side-dressed. The grain sorghum hybrid NC+ 6B50 was planted on June 6 at 51,000 seeds/a. Plots were 25 ft long and 10 ft (four 30-inch rows) wide with four replications in a randomized complete block.

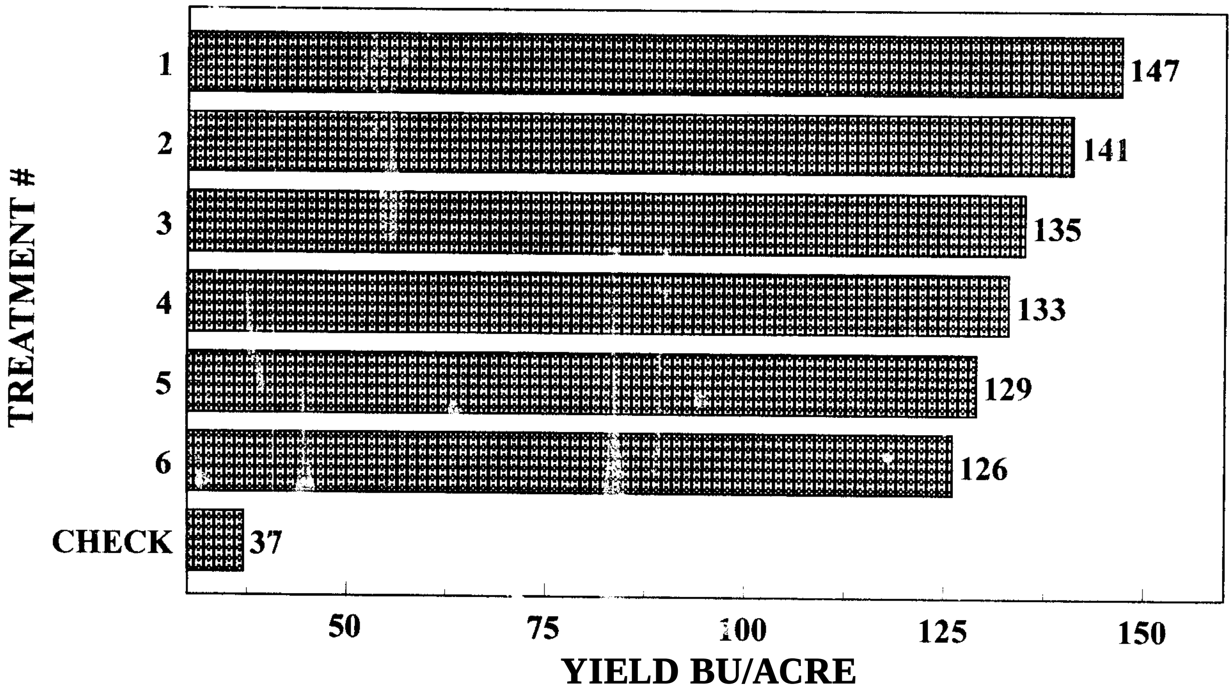
A total of 10 treatments was evaluated. Preemergence (PRE) treatments were applied on June 10. Postemergence (POST) treatments were not applied because extremely wet soil conditions would have resulted in severe rutting of the field. Treatments were applied using a tractor-mounted compressed-air sprayer at 30 psi and 20 gal/a water. Crop injury and weed pressure were monitored throughout the growing season. Grain was harvested mechanically, and yields were adjusted to 12.5% moisture.

Results

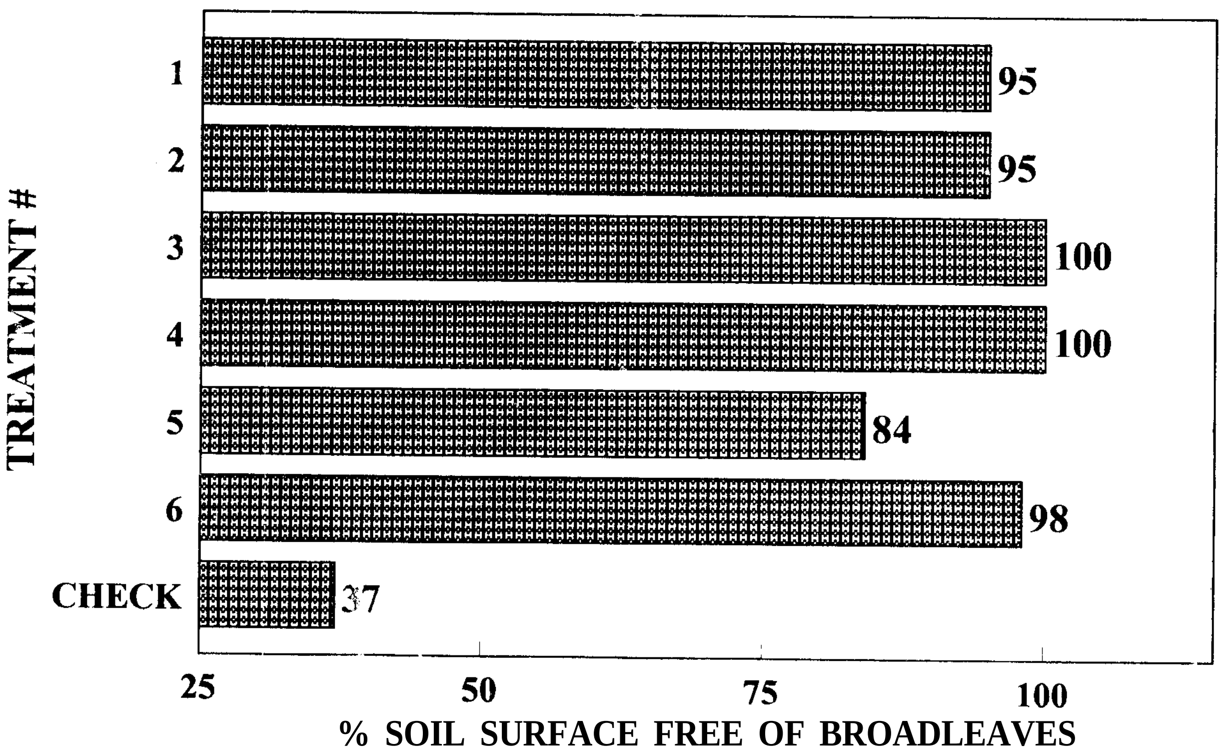
Treatments (Table 3) are listed in order of descending yield (Figure 1). No grass weed ratings are reported because all plots, even check plots, were essentially free of grass weeds. Broadleaf weed data are presented, and with the exception of the check, all PRE treatments resulted in very good to excellent control (Figure 1). Primary broadleaf weed pressure was from puncture vine, with some Palmer amaranth present, especially in treatments 5 and 6. Yield data are reported in order to demonstrate possible yield reduction from plant stunting and stand reduction caused by herbicides.

Yields for all plots, except the check, were well above the long-term area average of 60 bu/a. The best treatments involved Dual in combination with 0.8 lb a.i./a of Procaine or Atrazine. Little yield reduction occurred in 1997 with either triazine herbicide. This is not unusual because damage from PRE applications of Atrazine is a function of conditions in individual growing seasons.

Dual by itself did offer a fair amount of weed control but not as much as Dual in combination with procaine or Atrazine.



LSD(.05)= 12.2 BU/A



LSD(.05) = 12.2%

Figure 1. Sandyland. 1997 G rain Sorghum Herbicide Trial. Grain yield and broadleaf control.

Table 3. Herbicide treatments evaluated for grain sorghum,1997, Sandyland Experiment Field.

No. Treatment	Rate	Timing
	lb a.i./a	PRE/POST
1 Dual	2.0	PRE
Procaine	0.8	PRE
2 Dual	2.0	PRE
Atrazine	0.8	PRE
3 Dual	2.0	PRE
Procaine	0.4	PRE
4 Dual	2.0	PRE
Procaine	1.2	PRE
5 Dual	2.0	PRE
6 Dual	2.0	PRE
Atrazine	0.4	PRE
7 Check		

EFFECTS OF PLANTING DATE, IRRIGATION RATE, AND TILLAGE ON PRODUCTION OF VARIED-MATURITY CORN

Victor L. Martin, Gary A. Clark, Richard L. Vanderlip, Gerald W.Warmann, and Dale L. Fjell

Introduction

Corn is the most common and important cash crop in SC Kansas produced under irrigation, with 13% of the state's crop being produced in the nine county area of the Great Bend Prairie. The sandy soils and climate of the region in combination with irrigation result in average yields of 150 to 160 bu/a in most years. Under intensive management with favorable weather, yields of 190 to 200+ bu/a are expected on producers "better" fields. Typically, corn is planted from mid-April to mid-May with populations averaging 24,000 to 28,000 plants/a. Normally, a full-season hybrid (112 days or greater to black layer) is planted, although hybrids of shorter maturity are increasing in popularity.

Even though irrigated corn production has been an economic boom to Kansas, it has not been without problems, especially in western Kansas, where aquifer depletion is a major concern. Although vast improvements have been and are being made in irrigation technology, many questions remain.

The aquifer in SC Kansas in the region of the Great Bend Prairie has not seen the dramatic decrease in water levels that western Kansas has. The structure of the aquifer and the soils of the region have allowed for lesser decreases, and significant recharge of the aquifer in much of the region has occurred in years of high rainfall such as the mid-1970's, 1992, 1993, 1996, and 1997. This fact enables groundwater to be viewed as a renewable resource, especially with careful management of irrigation and agronomic systems to maximize water use efficiency.

An additional factor compounds the view of sustainable irrigation, especially in the Rattlesnake Creek Watershed, where the Quivira National Wildlife Refuge is located and from which it receives its water. Although groundwater can be viewed as renewable for irrigators, the lowering of water table levels associated with irrigation has diminished stream flow into Quivira and resulted in less water than needed to maintain the refuge during periods of below-normal precipitation. The results are not only strategies to manage irrigation to sustain itself, but also practices to help ensure adequate surface waters to maintain the Quivira Wildlife Refuge. Although switching hardware on pivots and using irrigation scheduling potentially will help decrease irrigation inputs, the selection of proper agronomic practices (planting date, tillage, hybrid maturity) can be as important in reducing water usage. This study is one aspect of the solution.

The primary objective of this study is to determine the effects of no-tillage vs. conventional tillage, hybrid maturity, planting date, level of irrigation inputs, and their interactions on the yield, water usage, and economic return for corn produced on the sandy soils of SC Kansas. This is the second year of a multiyear study. The study involves the departments of Agronomy, Biological and Agricultural Engineering, and Agricultural Economics. Support for this project has been provided by the Kansas Corn Commission.

Procedures

The soil for this study is predominantly loamy fine sand with some fine sandy loam. The site was cropped to grain sorghum in

1994 and 1995 and to wheat in the prior 2 years. Fertilization consisted of 100 lb/a 18-46-0 each year in March. Nitrogen was applied as granular urea (46-0-0). The application was split in two 125 lb N/a increments, preplant and V6. All planting dates received 1 qt/a Dual II + 1 pt/a Atrazine preemergence followed by 1 qt/a Marksman post emergence. The first two planting dates also received 2/3 oz/a Accent to control crabgrass and volunteer grain sorghum in 1996. All plots were planted at 34,000 seeds/a with a John Deere no-till row planter.

Treatments were as follows:

1. Main plots - planting date: April 16, May 2, May 15 (1996); April 21, May 5, May 19 (1997).

2. Split plots - irrigation level: 120% (0.92 in./application), 100% (0.78 in./application), 80% (0.62 in./application).

3. Sub-subplots - tillage: no-tillage, chisel-disk

4. Final split plots - corn hybrid: early (Pioneer 3563-103 day), medium (Dekalb DK 591-109 Day), full (Pioneer 3162-118 day)

Plots were arranged in a randomized complete block with four replications. Irrigation level differences were achieved by replacing the overhead system with drops, pressure regulators, and three different nozzles that allowed application of different rates.

Measurements included final plant population, dates of 50% emergence and silking, grain yield, and grain moisture.

Results

As the data show part of the site where the medium irrigation rate was applied contained large variations in corn yield, most likely related to soil compaction. The differences were larger for 1996 than 1997. This resulted in wide yield variation and lower than expected yields. The treatments will be moved in 1998 to avoid this problem area.

Precipitation was much above normal during both growing seasons and resulted in the need for less irrigation than normal (Table 4). The maximum difference in water applied was 2 inches in 1996 and 2.1 inches in 1997.

Mid-May planting significantly decreased yield overall; increasing irrigation levels slightly increased yield in 1996 and had no effect in 1997 (Figure 2). No-tillage resulted in lower yields in 1996 and had no significant effect in 1997 (Figure 2). The 108- and 103-day hybrids were competitive with the 118-day hybrid (Figure 2).

Overall, the two early hybrid yields were unaffected by planting date, and yields decreased with increasing maturity and planting date (Figure 3). Yields of all three hybrids were lower overall with the no-tillage system in 1996 and unaffected by tillage in 1997 (Figure 4).

Figures 5 and 6 show overviews of all treatment variables. Two years into the study, several trends are becoming evident, at least for years of above-normal precipitation and humidity and relatively mild temperatures during the growing season.

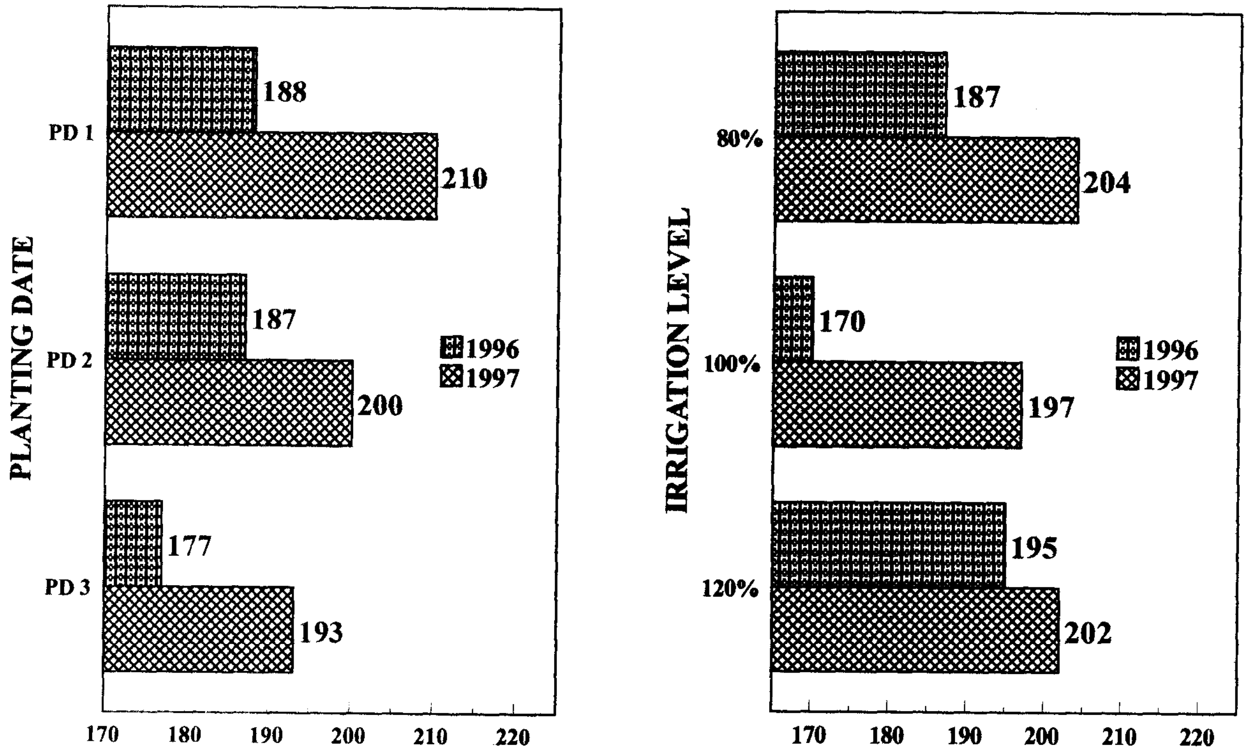
Planting date has been the single most important variable in determining yield. As planting is delayed, yields decrease significantly. Overall, eliminating tillage has not resulted in significant yield reductions. Earlier maturing hybrids are competitive with a full-season hybrid and are relatively less sensitive to planting date. Finally, during these two mild, wet years, decreasing irrigation did not adversely affect yields.

We now need to collect data under less ideal growing conditions to help determine how these variables will affect corn grain yield.

After we have information across a wide range of growing season conditions, we will be able to discuss the agronomic and economic consequences of the interactions of planting date, irrigation level, tillage, and hybrid maturity and start to make recommendations.

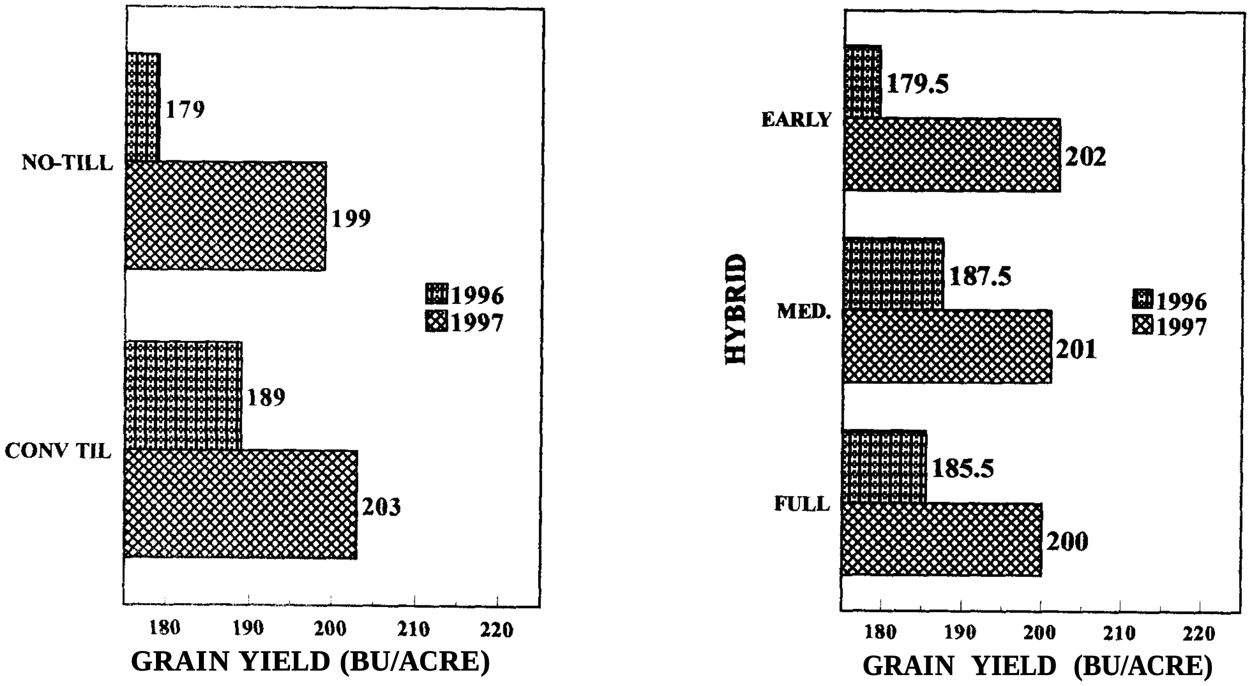
Table 6. Numbers and amounts of irrigation in corn study, 1997-1997, Sandyland Experiment Field.

		Irrigation Rate and Total (inches)		
Planting Date and Irrigation Level	Irrigation Number	80%	100%	120%
April 16, 1996	9	3.7	4.0	4.3
May 2, 1996	11	4.3	4.8	5.3
May 15, 1996	12	4.6	5.2	5.7
April 21, 1997	7	4.3	5.5	6.4
May 5, 1997	7	4.3	5.5	6.4
May 19, 1997	7	4.3	5.5	6.4



LSD(.05) = 10 (1996); 10.7 (1997)

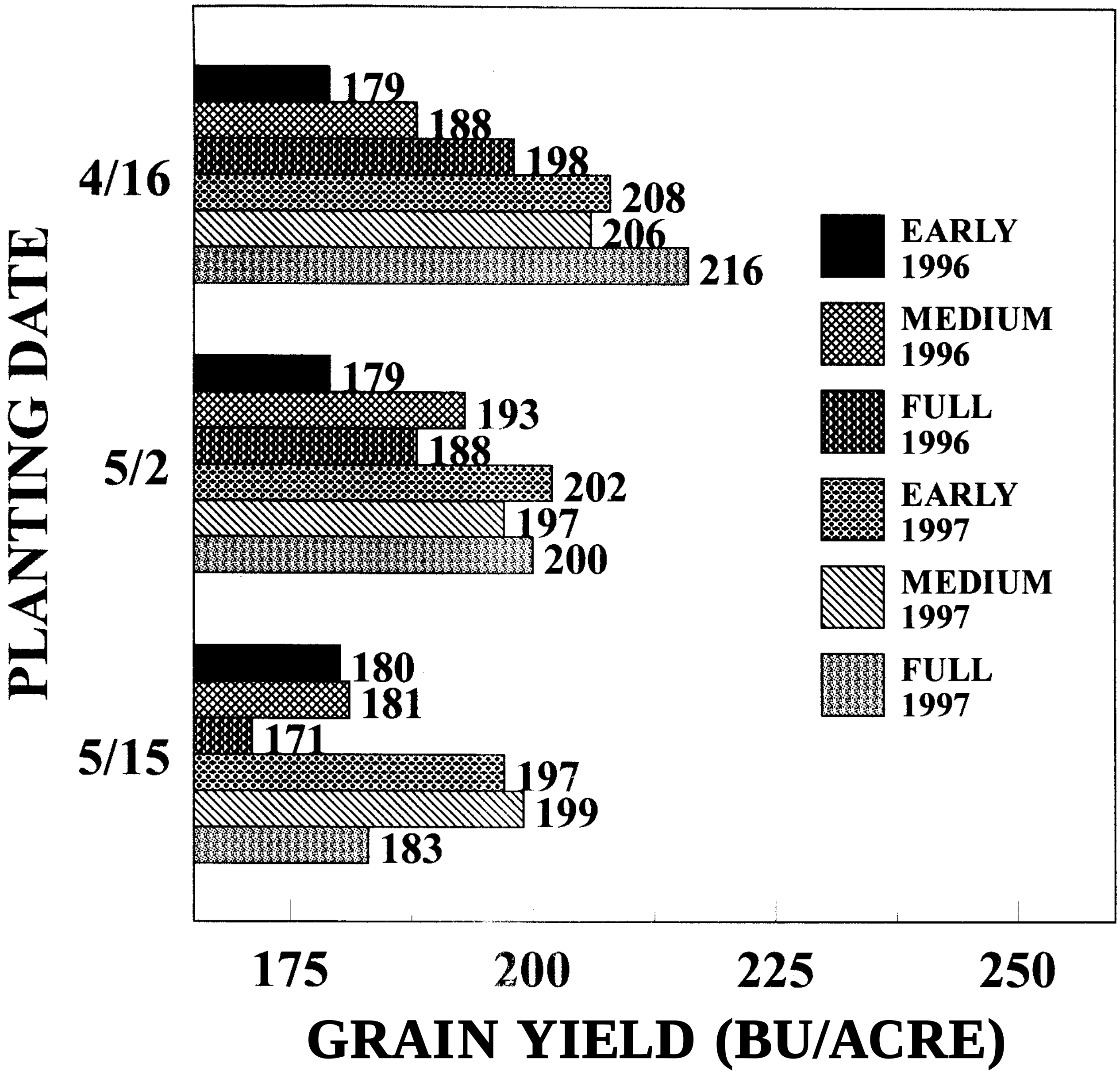
LSD(.05) = 8.6 (1996); 4.5 (1997)



LSD(.05) = 6.6 (1996); NS (1997)

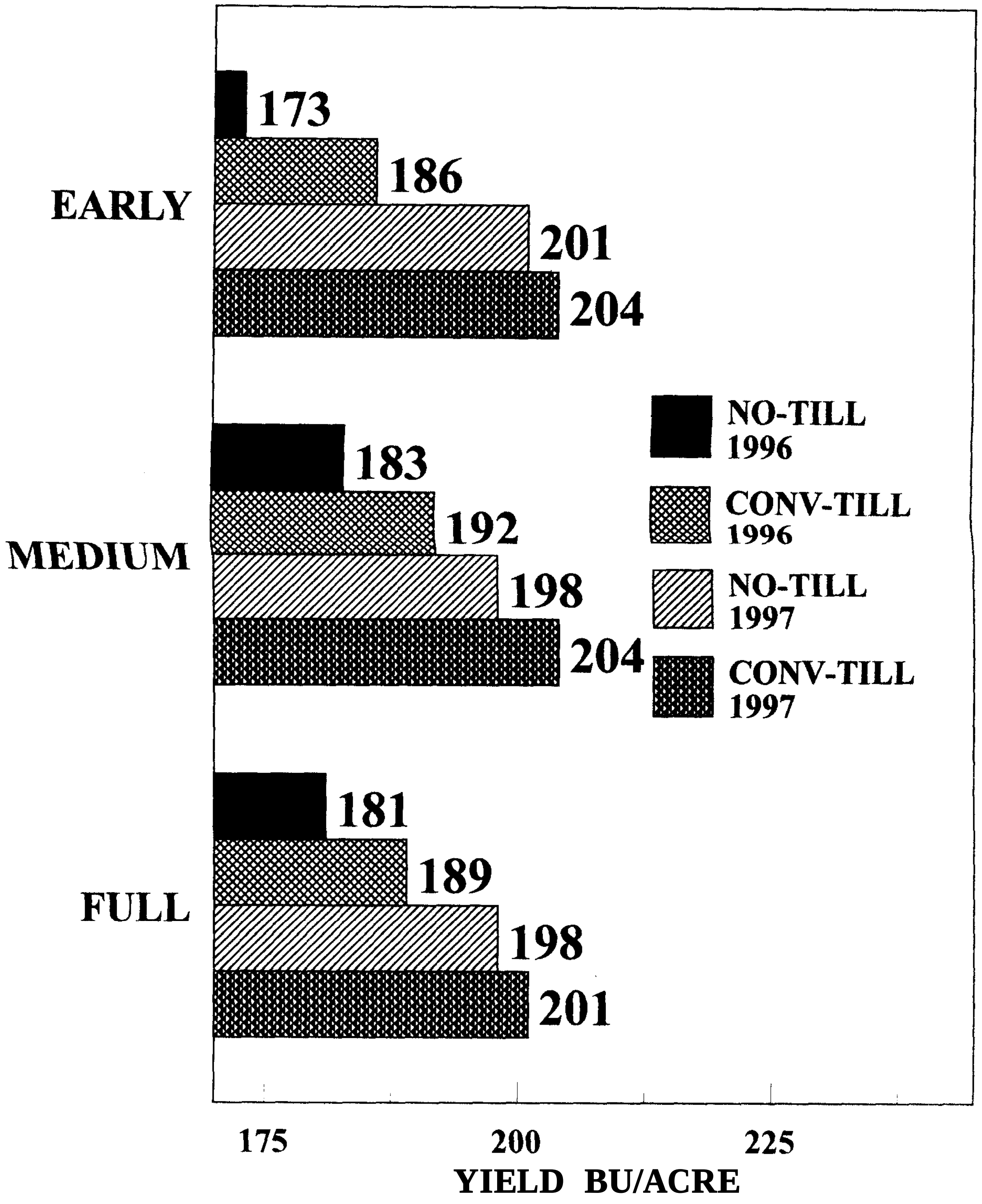
LSD(.05) = 6.6 (1996); NS (1997)

Figure 2. Sandyland. 1996 Planting date X irrigation level X tillage X hybrid maturity study. Corn grain yields.



LSD(.05) = 7.1 (1996); 6.3 (1997)

Figure 3. Sandyland. 1996-1997 Irrigated corn study. Interaction of hybrid with planting date.



LSD(.05) = NS (1996 & 1997)

Figure 4. Sandyland. 1996 Irrigated corn study. Interaction of hybrid with tillage.

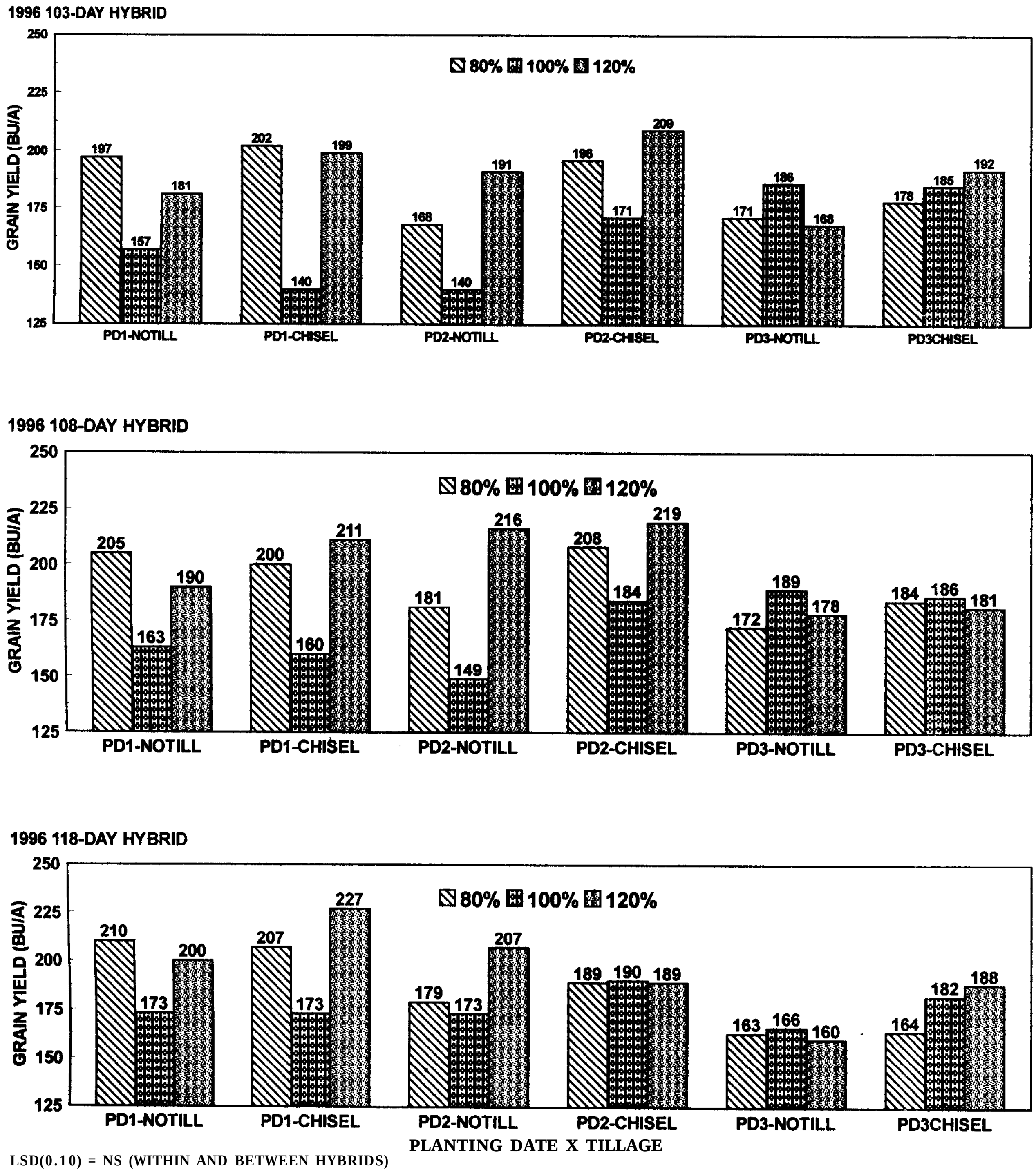
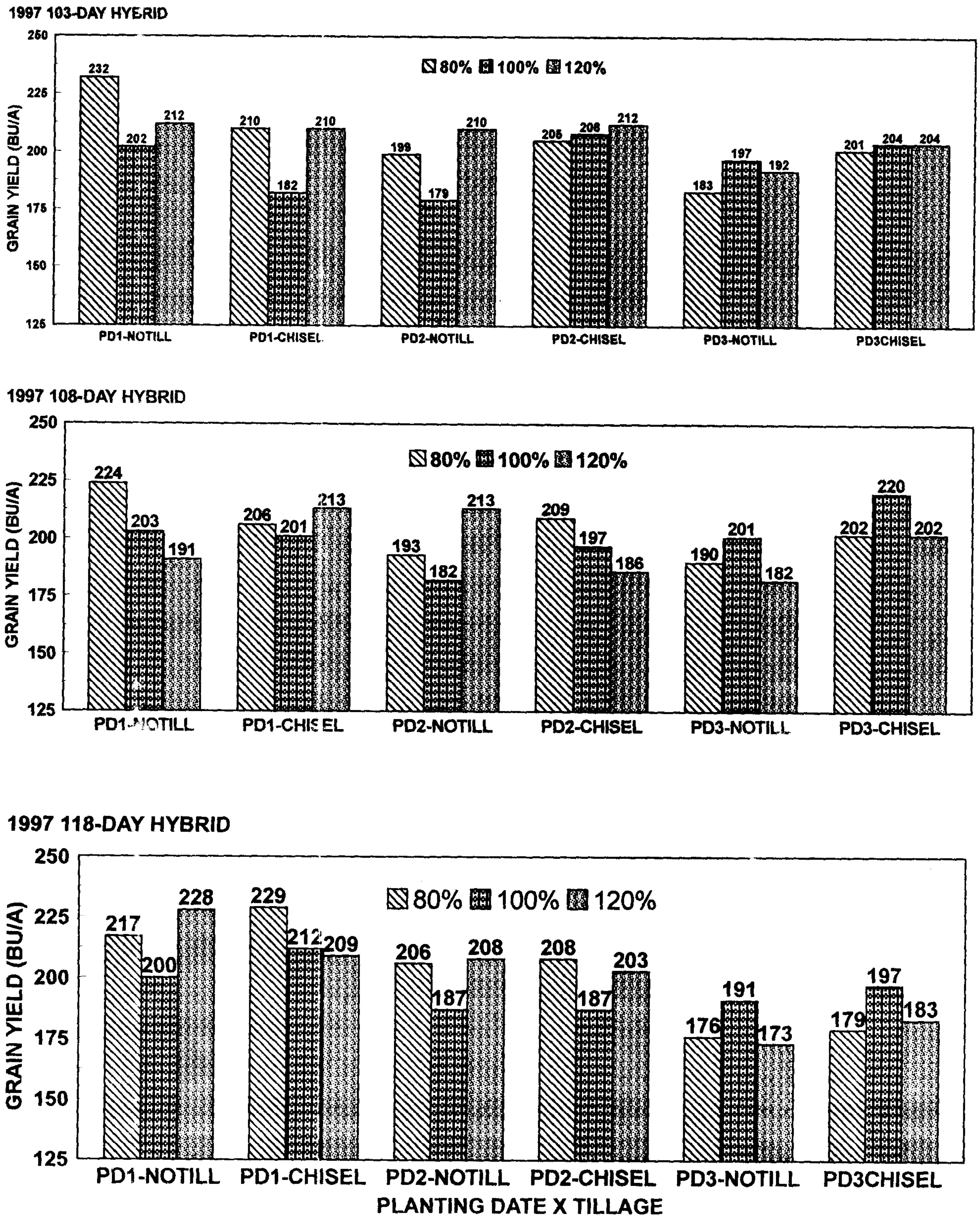


Figure 5. Sandyland. 1996 Corn grain yield by hybrid maturity using planting date X irrigation level X tillage interaction.



LSD(0.10)= 5.3 (WITHIN AND ACROSS HYBRIDS)

Figure 6. Sandyland. 1997 Corn grain yield by hybrid maturity using planting date X irrigation level X tillage interaction.

YIELD AND ECONOMIC FEASIBILITY OF A GRAIN SORGHUM-WHEAT ROTATION ON DRYLAND SANDY SOILS

Victor L. Martin, Richard L. Vanderlip, and Gerald W. Warmann

Introduction

Although Kansas typically leads the nation in grain sorghum production, dryland wheat acreage dwarfs that of grain sorghum. The practice of continuous long-term wheat production is slowly changing, but much dryland ground is still in continuous wheat. The new Freedom to Farm legislation and several other factors will speed the change from continuous wheat.

Continuous wheat on the sandy soils of south central Kansas causes several problems. Continuous wheat production on the highly erodible soils typical of the Great Bend Prairie must entail leaving significant amounts of wheat straw on the soil surface (reduced tillage) for a producer to remain in compliance with NRCS guidelines. As tillage is decreased and straw is allowed to accumulate on the soil surface, disease pressure increases; volunteer wheat and weeds, especially cheat, are more difficult to control; and the residue itself can be difficult to plant through. Crop rotation can play a major role in managing these problems, while maintaining adequate surface cover.

Presently, two crops are most practical for dryland crop rotations on the sandy soils of the region, corn and grain sorghum. Dryland corn production in the area has been increasing over the last 6 years. The two major advantages when rotating wheat with corn are being able to safely apply Atrazine at spring planting to control cheat and usually to harvest the corn in sufficient time to return to wheat. Planting dryland corn has some major disadvantages. It entails greater risk and management skills, especially on sandy soils. If the summer is hot and dry and timely rains, particularly near flowering, do not occur, the producer risks yields of 20 to 30 bu/a or less. Eliminating tillage and weed pressure are also critical to maximize available water, much more so than under irrigation. Other disadvantages are the increased input costs and the need for different equipment than is used for wheat.

Rotating with grain sorghum is the other primary option. Sorghum has the advantage of being better able to withstand drought, produce more consistent yields, and produce less residue to manage. The disadvantages include the inability to safely use Atrazine preemergence on sandy soil and use of available soil water for a longer period of time during the growing season. Most importantly, it is difficult, if not impossible, to harvest the sorghum and return to wheat in the same season. This has meant that farmers rotating out of wheat to sorghum have had a fallow year before returning to wheat. The need to idle land for a year has resulted in many producers being unwilling to rotate to sorghum until or unless weed and disease pressures result in almost negligible yields. If producers could successfully plant a shorter season grain sorghum significantly earlier than the typical mid- to late- June planting date and minimize the amount of tillage involved, they may be able to introduce sorghum for 1 to 3 years, correct their continuous wheat problems, and return to wheat without losing a cropping season.

The primary objective of this study is to determine the agronomic and economic feasibilities of a long-term grain sorghum-wheat rotation compared to continuous wheat. The study also will determine the effect of tillage, weed control intensity, planting date, and their interactions on the yield and quality of grain sorghum and wheat.

Procedures

The soil for this study is a fine sandy loam. The site was cropped to wheat for 2 years prior to planting in 1996 and 1997. Fertilization consisted of 100 lb/a 18-46-0 preplant with 120 lb/a N applied as urea (46-0-0) using a split application with 50 lb/a N preplant and 75 lb/a side-dressed in both years. Plots were planted with a six-row John Deere no-till planter on the appropriate date at 51,000 seeds/a. Entire plots were harvested mechanically in mid-October. Grain moisture and test weight were determined, and all yields were adjusted to 12.5% moisture. Dates of 50% emergence and bloom, final plant population, heads/plant, and final plant height also were determined. Wheat, 2163, was planted on October 25 at 90 lb/a using a Marliss no-till 10 in. drill. Wheat will be harvested and total system yields determined.

Treatments were as follows:

1. Main plots: planting date - May 21, June 10 (1996); May 21, June 3 (1997).

2. Split plots: tillage - no-tillage and conventional (chisel-disk).

3. Split-split plots: weed control - standard (Dual followed by Marksman); no-till (preplant weed control with Roundup or Landmaster; conventional preplant control by tillage); reduced (preplant with no-till using Roundup and a rescue treatment of 2,4-D or Banvel if necessary; conventional tillage will have only tillage for weed control and a 2,4-D or Banvel rescue treatment if necessary).

4. Final split: grain sorghum hybrid maturity - early maturity (NC+ 5C35) and medium maturity (NC+ 6B50).

The study also includes a continuous wheat treatment using the above factors for comparison. The tillage and weed control levels will be carried out during the wheat crop and fallow periods. Plots were planted in a randomized complete block design with four replications.

Results

Precipitation was much above average during the 1996 and 1997 growing seasons (Table 1), and temperatures were relatively mild. The wet conditions from May through June prevented the application of Marksman, so the standard weed control treatment consisted of Dual only in 1996. The study calls for harvesting sorghum by the first of October and having wheat planted by the second week of October. The wet cool conditions of August and September delayed maturity, and therefore, harvest and wheat planting in both years. Wheat was not planted until late October, and yields averaged approximately 35 bu/a regardless of treatments, except for the no-herbicide conventional tillage treatments that were unharvestable because of weeds. Planting on May 21 versus early June increased yields overall, regardless of tillage and weed control levels (Figure 7). Overall, no-tillage yields were lower than conventional tillage yields in 1996 but not significantly so. In 1997, no-tillage yields were slightly higher than those under conventional tillage. The conventional weed control treatment (Dual only in 1996) significantly increased yields over no herbicide inputs, and the medium maturity hybrid (NC+ 6B50) significantly outyielded the early maturity hybrid (NC+ 5C35) (Figure 8). We should note that the long-term, area, average yield of sorghum is approximately 50 to 60 bu/a. Yields in 1996 and 1997 were exceptionally high throughout the region.

Overall, herbicide was necessary regardless of planting date or tillage (Figure 9).

9). These figures also show the large yield increase by planting just 2 weeks earlier, even under less than ideal conditions. Examining all the treatment combinations by hybrid (Figure 10) shows the greater yield consistency with earlier planting. Also note the competitiveness of no-tillage with the chisel-disk system under the conventional herbicide treatment.

Examining the interaction of all factors demonstrates the benefits of planting earlier regardless of hybrid maturity (Figure 10) and the need for chemical weed control inputs regardless of tillage when planting early. Finally, these data show no-tillage to be competitive with conventional tillage, even when planting early during a cool, wet spring.

Although no conclusions can be drawn yet, the initial data indicate the potential for success in eliminating tillage, while moving sorghum planting earlier into the growing season.

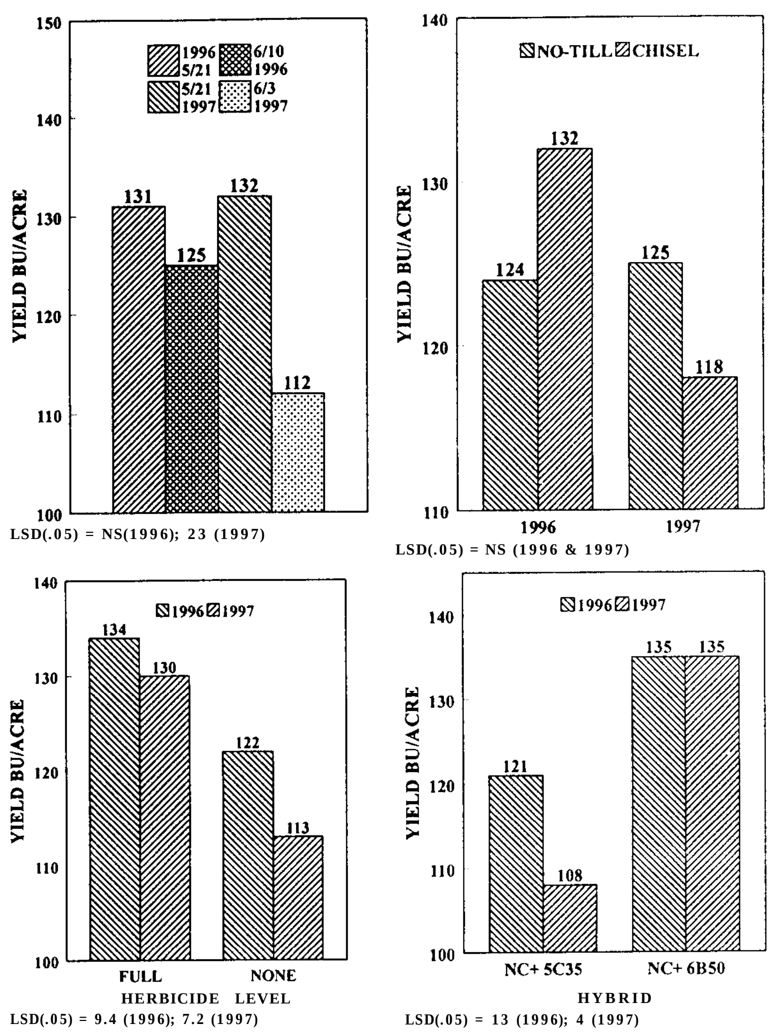
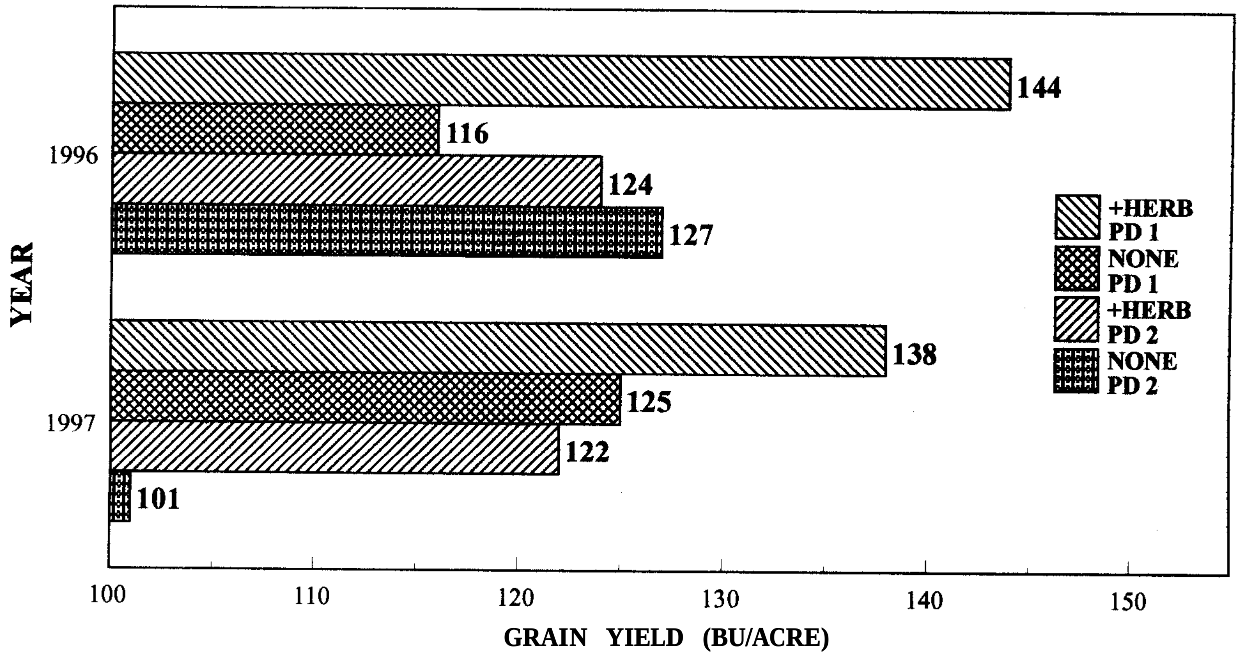
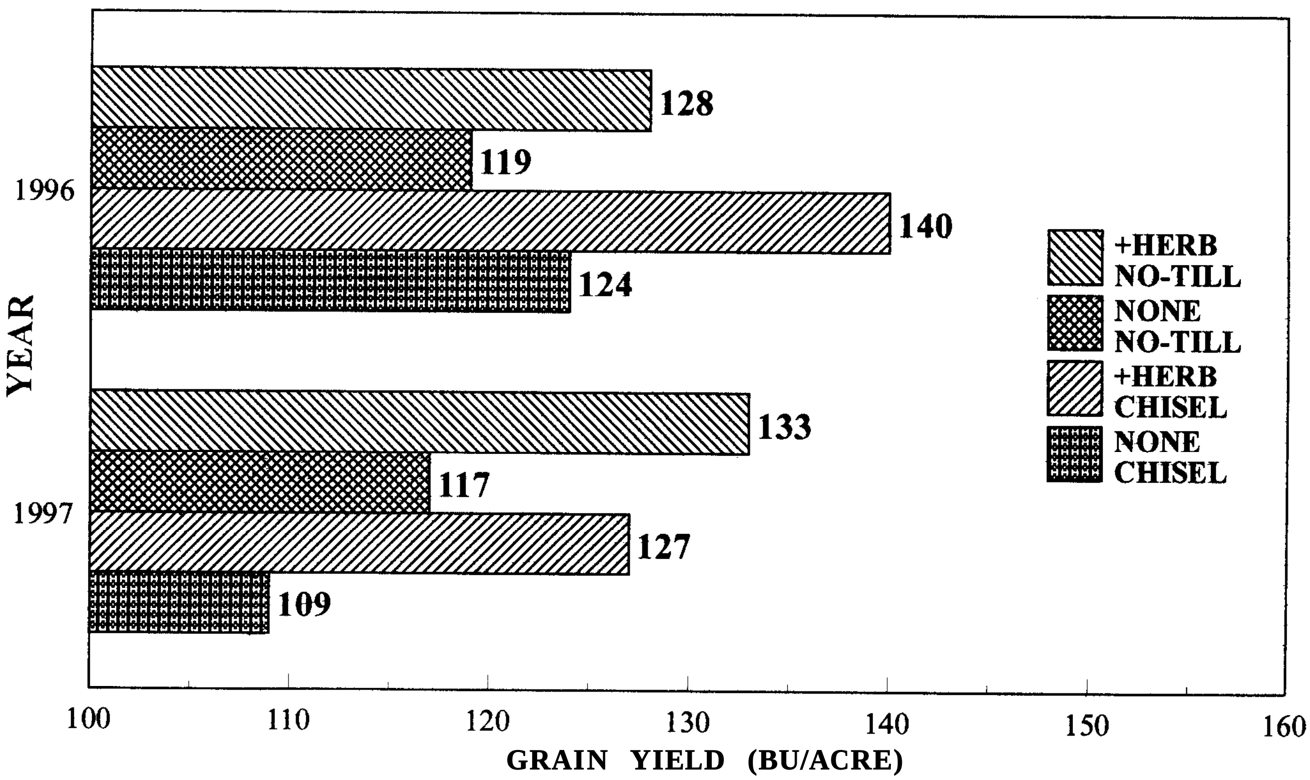


Figure 7. Sandyland. 1996. Effect of tillage X planting date; herbicide level X planting date; herbicide level X tillage; and tillage X herbicide level X planting date on grain yield.



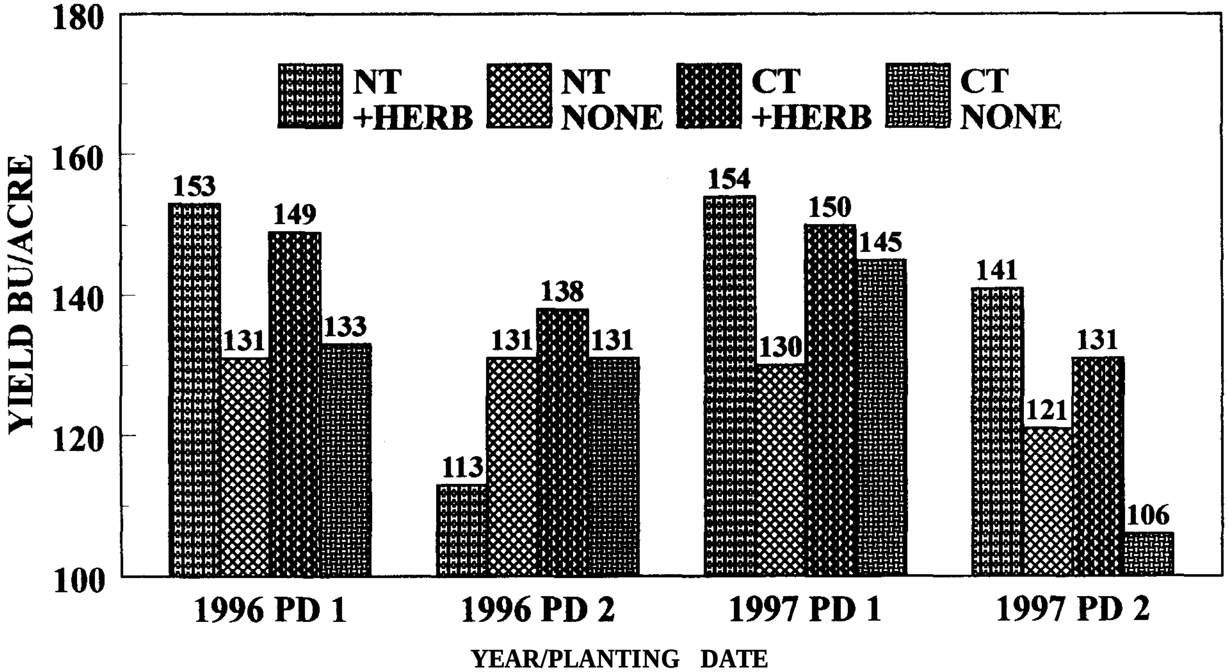
LSD(.05) = 13.3 (1996); 7.2 (1997)



LSD(.05) = 9.4 (1996); 16.7(1997)

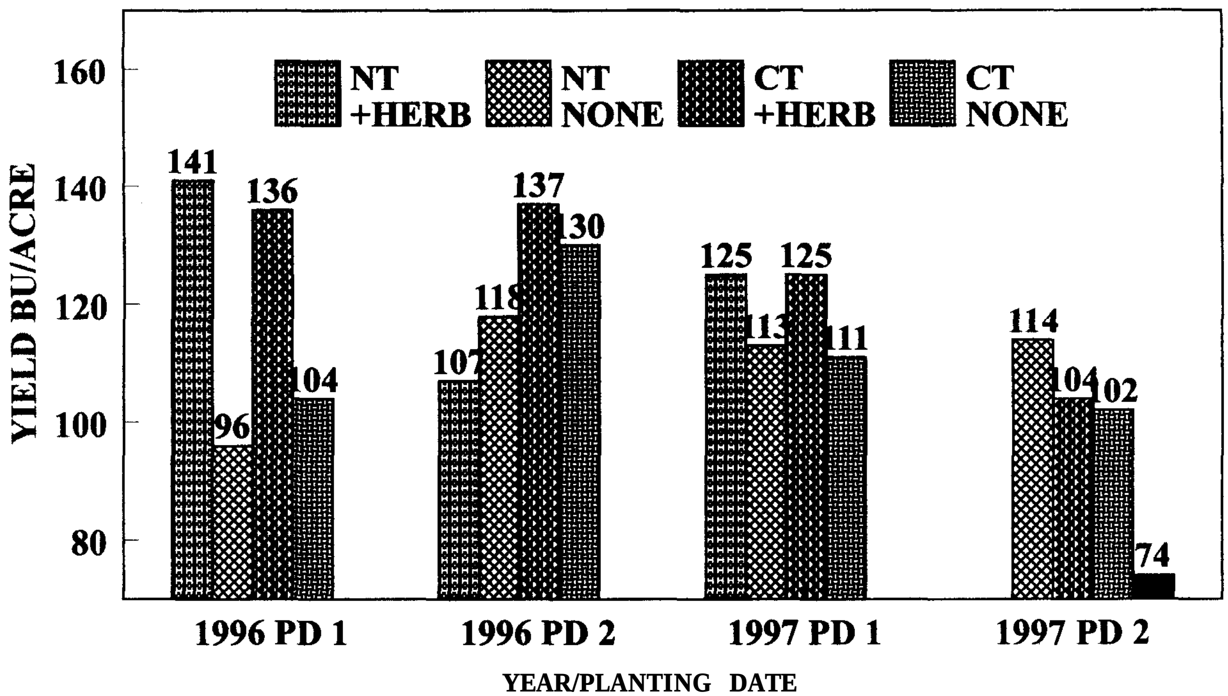
Figure 8. Sandyland. 1996-1997 Grain sorghum planting date X tillage X herbicide level X hybrid study. Grain yield.

NC+6B50(MEDIUM MATURITY)



LSD(.05)=NOT SIGNIFICANT

NC+ 5C35 (EARLY MATURITY)



LSD(.05)=NOT SIGNIFICANT

Figure 9. Sandyland. 1996-1997. Effect of herbicide level X planting date and herbicide level X tillage on grain sorghum yield.

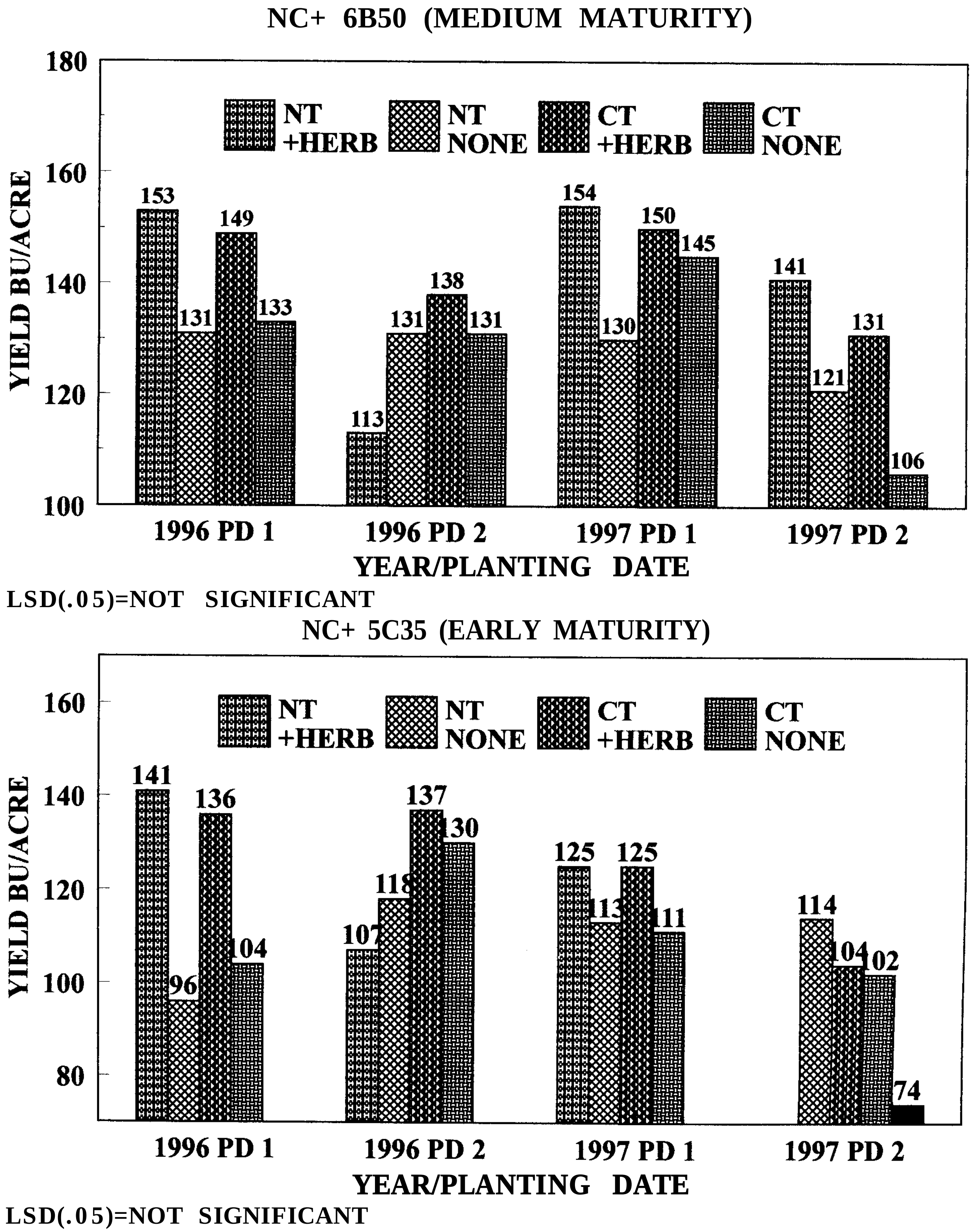


Figure 10. Sandyland. 1996-1997. Interaction of planting date X tillage X herbicide level by hybrid maturity.

SOUTH CENTRAL KANSAS EXPERIMENT FIELD

Introduction

The South Central Kansas Experiment Field was established in 1951 on the US Coast Guard Radio Receiving Station located southwest of Hutchinson. The first research data were collected with the harvest of 1952. Prior to this, data for the South Central area of Kansas were collected at three locations (Kingman, Wichita, and Hutchinson). The current South Central Field location is approximately 3/4 miles south and east of the old Hutchinson location on the Walter Peirce farm.

Research at the South Central Kansas Experiment Field is designed to help the area's agriculture develop to its full agronomic potential using sound environmental practices. The principal objective is achieved through investigations of fertilizer use, weed and insect control, tillage methods, seeding techniques, cover crop and crop rotation, variety improvement, and selection of hybrids and varieties adapted to the area. Experiments deal with problems related to production of wheat, grain and forage sorghum, oats, alfalfa, corn, soybeans, rapeseed/canola, and sunflower and soil tilth. Breeder and foundation seed of wheat and oat varieties are produced to improve seed stocks available to farmers. A large portion of the research program at the field is dedicated to wheat breeding and germplasm development.

Soil Description

The soil survey for the South Central Field has approximately 120 acres classified as nearly level to gently sloping Clark/Ost loams with calcareous subsoils. This soil requires adequate inputs of phosphate and nitrogen fertilizers for maximum crop production. The Clark soils are well drained and have good water-holding capacity. They are more calcareous at the surface and less clayey in the subsurface than the Ost. The Ost soils are shallower than the Clark, having an average surface layer of only 9 inches. Both soils are excellent for wheat and grain sorghum production. Large areas of these soils are found in southwest and southeast Reno County and in western Kingman County. The Clark soils are associated with the Ladysmith and Kaski soils common in Harvey County but are less clayey and contain more calcium carbonate. Approximately 30 acres of Ost Natrustolls Complex, with associated alkali slick spots, occur on the north edge of the Field. This soil requires special management and timely tillage, because it puddles when wet and forms a hard crust when dry. A 10-acre depression on the south edge of the Field is a Tabler-Natrustolls Complex (Tabler slick spot complex). This area is unsuited for cultivated crop production and has been seeded to switchgrass. Small pockets of the Tabler-Natrustolls are found throughout the Field.

1997 Weather Information

Precipitation in 1997 totaled 32.16 inches, 2.67 inches above the 30-year average of 29.49 inches (Table 1). As in previous years, precipitation in 1997 was not distributed evenly through the year or within a given month. The highest monthly total was recorded in June (6.92 inches). This year, when the monthly totals were high, most of the precipitation was received in one or two high rainfall events but not heavy downpours. Because of this and the extended dry periods prior to the rain, most of the water received did not run off and was considered beneficial to crop production. The soil conditions at planting of the 1997 winter wheat crop (October 1996) were good because of the above-normal rainfall received in July, August, and September of 1996. After planting, precipitation was considerably below the long-term average (except for November and February), and the air temperatures averaged slightly above normal. These conditions resulted in excellent wheat growth and a considerable number of fall tillers. The freezing weather in mid-April caused considerable concern. The moisture and temperature conditions in May and June were favorable for grain filling. These conditions allowed for near-normal to above- normal wheat yields.

The below-normal temperatures and above-normal precipitation in July, August, and September were very beneficial for the grain sorghum and other summer annual crops. Soil moisture at wheat seeding time for the 1997 crop was considered excellent. A frost-free growing season of 178 days (April 23 - October 18, 1996) was recorded. This is 5 days less than the average frost-free season of 183 days (April 19 - October 17).

Table 1. Precipitation at South Central Kansas Experiment Field, Hutchinson.

Month	Rainfall (inches)	30-Yr Avg* (inches)	Month	Rainfall (inches)	30-Yr Avg (inches)
1996			April	2.90	2.91
September	4.74	2.96	May	2.60	4.27
October	1.41	2.45	June	6.92	4.18
November	3.00	1.33	July	2.17	3.18
December	0.22	0.96	August	4.09	3.06
1997			September	5.74	3.09
January	0.02	0.59	October	2.40	2.48
February	2.23	0.93	November	0.29	1.43
March	0.34	2.38	December	2.46	0.95
			1997 Total	32.16	29.49

* Most recent 30 years.

EFFECTS OF TILLAGE AND NITROGEN FERTILIZER ON ALFALFA

William F. Heer, Kraig L. Roozeboom, and James P. Shroyer

Introduction

Several questions have been asked regarding the effects of preplant tillage and application of nitrogen (N) fertilizer on establishment of alfalfa. To answer some of the questions, research studies were established, using four preplant tillage systems and four N rates applied at seeding. The previous crops were winter wheat for the first preplant tillage study and oats for the others.

Procedures

The tillage study in wheat stubble was planted in the fall of 1990. Differences in dry matter production occurred among tillage systems in the first year but did not continue into the second and third years. This indicated that tillage may affect yield in the year of establishment, but thereafter no yield differences should be realized when planting alfalfa into wheat stubble. A similar study established in oat stubble in the fall of 1992 is being continued. As with the wheat stubble study, this study was designed to evaluate stand establishment and yield under four tillage systems (conventional, disk, no-till burn, and no-till) prior to planting. Fall establishment of alfalfa was good in all tillage treatments. However, in the spring, the stand in the no-till plots appeared to be thinning out (a condition that occurred in a previous planting). To evaluate this condition, a third study was established using only no-till practices with five alfalfa varieties (Kanza, Riley, Cody, KS 1002, and KS 1001) and four rates of N fertilizer (0, 50, 75, and 125 lb/a) applied at seeding time. Data for plot weight, subsample wet and dry weights, and plant height were taken. The plot weight and subsample wet and dry weights were used to calculate dry matter production on a per acre basis.

Results

The alfalfa in the no-till plots (that seeded into standing oat stubble in 1992) showed signs of stand thinning and desiccation. However, sufficient stands persisted, and the data from this seeding were collected in 1993-96. In 1993, the first cutting differences were sufficiently large to cause significantly different total yields among tillage treatments. The no-till burn treatment had the greatest yield, followed by offset disk and conventional and no-tillage treatments, which had equal dry matter yields. The wet April of 1994 resulted in no significant differences in yield by tillage for the first cutting. As the summer of 1994 became hot and dry, yields were reduced and differences became apparent. However, by the end of the growing season, no significant differences in dry matter yield occurred among treatments (preplant tillage). In 1995, only three cuttings were taken from these plots because of a cold wet spring and hot, dry weather in July and August. These conditions appear to have affected the offset disk treatment more than the others, because it produced significantly lower total yield than the other three treatments. This follows the trend that was seen in the earlier study with alfalfa seeded into wheat stubble; the offset disk treatment also had reduced yields. The cool wet conditions of 1996 resulted in no total yield differences. This study was discontinued at the end of the 1996 growing season.

The study with varieties and N rates was cut three times for dry matter yield in 1997. The dry matter yields for 1995, 1996, and 1997 are listed in Table 2. The only significant differences among cutting dates in 1996 occurred at the 75 lb/a N rate for the second cutting and the 0 N rate for the third cutting. These differences were the results of Riley having lower yields than the other varieties. Where the yearly total yields were significant (Kanza, Cody, and KS1001), only the 0 N treatment produced significantly lower yields.

Significant differences occurred among cutting date in 1997 but were very slight, with Riley consistantly yielding lower that Kanza. No differences occurred between Riley and the other three varieties, and the same was true of Kanza. Total yields for the year showed the same relationships (except that Kanza produced a higher yield than Riley). The only differences among N rates occurred at the 125 lb/a N rate in the first cutting. This treatment gave a significantly lower yield that the 0 N rate treatment but not the other two N rates. The 0 N rate treatment had yields equal to those of the 50 and 75 lb/a N rate treatments.

Table 2. Dry matter yield of alfalfa seeded into oat stubble with starter N fertilizer, South Central Kansas Experiment Field, Hutchinson.

	Kanza			Riley			Cody			KS1002			KS1001		
N Rate	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997
lb/a								t/a[1]							
0	1.7	4.5	6.7	1.3	4.1	5.8	1.4	4.4	6.2	1.4	4.8	6.5	1.4	4.2	6.2
50	1.5	4.7	6.5	1.3	4.6	5.5	1.5	4.6	6.3	1.5	4.7	5.8	1.5	4.6	6.2
75	1.7	5.2	6.7	1.2	4.4	5.8	1.4	4.4	5.8	1.5	4.6	6.2	1.5	5.0	6.1
125	1.7	5.2	6.7	1.6	4.6	5.7	1.0	5.1	6.0	1.0	4.7	6.2	1.5	4.8	5.7
L.S.D. (P=0.05)	NS	0.7	NS	NS	NS	NS	NS	0.7	NS	NS	NS	NS	NS	0.7	NS

Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.
[1] Dry matter basis.

OATS FOR GRAIN AND FORAGE

William F. Heer, Kraig L. Roozeboom, and James P. Shroyer

Introduction

Oats are utilized not only for grain but also as a forage. Most of the time, oats planted for forage are utilized as a hay crop to feed livestock. The performance test reports for spring cereals did not include grain yields from oat varieties this year.

Procedures

Two sets of oat plots were planted on 9 March 1997 using the same plot drill and seeding rate. Soil conditions at planting were less than ideal because of the wet winter. These conditions delayed also planting date. At the hard dough stage, an attempt was made to cut the set of plots planted for forage yield. However, the soil conditions were so wet that the plots could not be cut, and the crop matured before reliable forage yield data could be obtained. The grain yield plots were harvested on 15 July 1997. The late harvest date was a result of later maturity caused by the cool wet weather conditions.

Results

The 1997 growing season was ideal for the production of oat grain. The early months were somewhat dry (Table 1), and the plants were stressed until April. The April 13 freeze delayed growth but did not kill the plants. Precipitation in May was below normal and temperatures were cool. Precipitation in June was again above normal, and the temperatures were lower than normal. This again slowed plant development. Thus, the major factor affecting yields in 1997 (Table 3) was the unusually cool, moist weather during grain filling. The data for forage dry matter from 1995 and 1996 are summarized in Table 4. Oat varieties need to be evaluated for either grain or forage production, because a variety that has high grain yield potential may not have a high forage yield potential. Therefore another an attempt to evaluate forage yield will be made in 1998.

Table 3. 1997 Kansas Spring Oat Performance Test - South Central Kansas Experiment Field, Reno County.

Brand	Name	Yield[1]		TW[2]	MST[3]	Head[4]	Lodge
		bu/a	% avg	lb/bu	%	Julian	%
Colorado	Rio Grande	82.8	125.7	33.6	10.2	151.3	71.3
Illinois	Brawn	82.6	125.4	34.4	10.2	147.8	70.0
Wisconsin	Prairie	81.5	123.6	31.8	10.4	150.5	76.3
Wisconsin	Bay	81.1	123.1	32.2	10.0	152.8	41.3
Illinois	IL891730	79.7	120.9	34.6	10.5	155.8	66.3
Minnesota	Milton	71.7	108.8	33.4	10.5	152.5	8.8
Wisconsin	Gem	70.6	107.1	34.6	10.3	150.5	25.0
South Dakota	Troy	70.0	106.2	34.2	10.3	153.0	55.0
Illinois	Rodeo	69.2	105.0	32.7	10.4	148.8	25.0
Illinois	IL862081	68.8	104.3	33.5	10.1	145.8	15.0
Wisconsin	Horicon	65.4	99.2	33.0	10.5	146.3	22.5
Wisconsin	Belle	65.1	98.8	35.5	10.7	150.5	26.3
Ohio	Armor	64.9	98.5	34.7	10.4	147.5	38.8
South Dakota	Settler	64.3	97.6	34.9	10.7	147.0	35.0
North Dakota	Jerry	62.6	95.0	36.2	11.3	145.8	11.3
Wisconsin	Dane	61.0	92.6	33.1	10.4	142.0	7.5
KS FDN	Ogle	60.1	91.2	33.9	10.3	145.5	27.5
Indiana	INO9201	59.6	90.4	35.4	10.3	146.0	15.0
KS FDN	Larry	59.4	90.2	36.3	10.1	143.8	20.0
Illinois	Hazel	58.8	89.2	34.6	10.2	146.5	5.0
Ohio	Chairman	57.6	87.5	32.5	10.1	145.5	7.5
KS FDN	Don	56.8	86.2	37.1	10.4	144.0	21.3
Canada	Russell	56.7	86.1	31.5	10.8	159.5	40.0
Minnesota	Jim	56.3	85.4	36.2	10.5	145.0	8.8
KS FDN	Bates	54.1	82.1	36.5	10.2	144.3	7.5
Minnesota	Premier	52.6	79.9	37.8	10.7	145.3	30.0
Average		65.9	65.9	34.4	10.4	148.2	29.9
CV (%)		8.6	8.6	2.1	3.4	3.1	71.0
LSD (0.05)[5]		6.7	10.1	0.8	0.4	5.4	25.0

1. Bushels per acre (32 pounds per bushel) adjusted to a moisture content of 12.5 percent.
2. TW grain test weight at harvest.
3. MST grain moisture at harvest.
4. HEAD date when 50 percent of plants in a plot were headed (Julian date).
5. Unless two varieties differ by more than the LSD, little confidence can be placed in one being superior to the other.

PERFORMANCE TESTS WITH OTHER CROPS

William F. Heer and Kraig L. Roozeboom

Introduction

Performance tests for winter wheat, grain and forage sorghum, and sunflower were conducted at the South Central Kansas Experiment Field. This is the first year for the sunflower test. Results of these tests can be found in the following publications.

1997 Kansas Performance Tests with Winter Wheat Varieties. KAES Report of Progress 790.

1997 Kansas Performance Tests with Grain and Forage Sorghum Hybrids. KAES Report of Progress 799.

1997 Kansas Performance Tests with Sunflower Hybrids. KAES Report of Progress 801.

Table 4. Grain and forage yields of oat, South Central Kansas Experiment Field, Hutchinson.

	Yield		
		Dry Matter	
Variety	Grain 1996	1996	1995
	bu/a	t/a	
Armor	42	3.2	6.1
Bates	50	3.5	6.0
Bay	16	1.9	----
Belle	33	2.2	----
Brawn	60	4.0	5.9
Dane	25	1.2	5.8
Don	43	3.8	5.8
Gem	27	3.1	----
Hazel	29	3.2	6.1
Horicon	44	2.6	4.9
Larry	33	2.5	5.2
Ogle	35	2.7	6.2
Praire	52	3.9	6.2
Premier	52	3.3	5.7
Settler	----	----	5.0
Starter	27	1.8	4.7
Mean	37.5	2.9	5.7
$LSD_{(P=0.05)}$	12.7	0.6	0.6
C.V. $_{(\%)}$	28.5	13.4	7.5

EFFECTS OF SEED TREATMENTS ON WHEAT EMERGENCE AND YIELD

Robert L. Bowden, William F. Heer, Curtis R. Thompson, and Alan J. Schlegel

Introduction

Several new seed treatments are being tested for their effects on winter wheat in the Great Plains region. This study was designed to evaluate the effects of 11 seed treatments on emergence (fall stand), fall and spring growth (estimated by percent cover), and grain yield of winter wheat.

Procedures

A 1995 seed lot of hard red winter wheat variety Karl 92 with symptoms of scab was obtained from the Kansas Crop Improvement Association. Germination in a standard lab test was 63%. Seed was treated in a commercial slurry treater using a total volume of 16 fl oz/100 lb (cwt). Treatments applied are listed in Table 5. Gustafson Pro-Ized Seed Colorant was added at 0.2 fl oz/cwt to all unpigmented treatments including the nontreated check. Seed was planted at 50 lb/a at the South Central Experiment Field in Hutchinson, KS on 10 October and at the Southwest Research-Extension Center at Tribune, KS on 2 October. Planting depths were approximately 1.25 in. at Hutchinson and 1.75 in. at Tribune. The experiments at each location were arranged as a randomized complete block. Plots were 5 X 20 ft with five replicates at Hutchinson and 5 X 30 ft with four replicates at Tribune. Soil moisture at planting was good, and germination was fairly uniform. Seedling emergence was counted on 25 October at Hutchinson and 3 November at Tribune in two 3-ft sections of the middle row in each replicate.

Results

Plots at Tribune subsequently were lost to drought, extreme cold, and high winds during the winter. At Hutchinson, weather was dry in the late fall, winter, and early spring, but rains were adequate in May (Table 1). Foliar disease pressure and incidence of barley yellow dwarf were extremely low. The percent ground cover was estimated on 1 April, and plots were harvested with a small plot combine on 21 June. Yields were standardized to 60 lb/bu and 13% moisture (Table 5). At Hutchinson, stand counts for all treatments except Raxil-thiram, Baytan + Thiram 42S, and Vitavax Extra were significantly better than the check. No significant differences among treatments were detected for % ground cover or grain yield. This lack of difference most likely was due to the lack of any significant disease pressure at this location in 1996. At Tribune, stand counts revealed that none of the treatments was significantly better than the check, but the Raxil-thiram and Baytan + Thiram 42S treatments had significantly lower stands. This apparent phytotoxicity might have been related to greater planting depth at Tribune.

Table 5. Winter wheat stand, percent cover, and grain yield as affected by seed treatment, Hutchinson and Tribune, KS, 1996.

	Hutchinson			Tribune
Treatment and Rate (fl oz/cwt)	Stand	Cover	Yield	Stand
	(plants/3-ft)	(%)	(lb/a)	(plants/3-ft)
Check	37.8 A*	56	58.4	38.7 AB
Raxil-thiram (3.5)	38.5 AB	57	60.6	31.2 C
Baytan 30F (1.25) + Thiram 42S (2)	42.6 ABC	61	60.6	30.3 C
Vitavax Extra (3)	45.1ABCD	56	61.0	37.2 ABC
RTU Vitavax-thiram (6) + Gus LSP (0.25)	45.4 BCD	57	59.2	35.1 ABC
Vitavax 200 (4) + Gus LSP (0.25)	46.2 CD	61	62.2	35.7 ABC
Dividend 3F (0.5)	46.3 CD	57	56.8	34.4 BC
Raxil-thiram (3.5) + Gus LSP (0.25)	47.4 CD	63	59.0	33.5 BC
RTU Vitavax-thiram (6)	48.4 CD	59	59.0	42.3 A
RTU Vitavax-thiram (6) + Gaucho 480FS (2)	50.4 D	55	60.6	39.3 AB
Vitavax 200 (4)	51.0 D	55	59.6	35.7 ABC
LSD	7.4	NS	NS	6.5
CV	12.8	8.5	7.0	12.6

* Data within column followed by same letter are not significantly different according to Fisher's protected LSD (*P*=0.05).

EFFECTS OF NITROGEN RATE ON YIELD IN CONTINUOUS WHEAT AND WHEAT IN ALTERNATIVE CROP ROTATIONS IN SOUTH CENTRAL KANSAS

William F. Heer

Summary

The predominant cropping systems in South Central Kansas have been continuous wheat and wheat-grain sorghum-fallow. With continuous wheat, tillage is preformed to control diseases and weeds. In the wheat-sorghum-fallow system, only two crops are produced every 3 years. Other crops (corn, soybean, sunflower, winter cover crops, and canola) can be placed in these cropping systems. To determine how winter wheat yields are affected by these crops, winter wheat was planted in rotations following them. Yields were compared to continuous winter wheat under conventional (CT) and no-till (NT) practices. Initially, the CT continuous wheat yields were greater than those from the other systems. However, over time, wheat yields following soybeans have increased, reflecting the effects of reduced weed and disease pressure and increased soil nitrogen. However, continuous CT winter wheat seems to outyield NT winter wheat regardless of the previous crop.

Introduction

In South Central Kansas, continuous hard red winter wheat and winter wheat - grain sorghum - fallow are the predominate cropping systems. The summer-fallow period following sorghum is required, because the sorghum crop is harvested in late fall, after the optimum planting date for wheat in this region. Average annual rainfall is only 29 inch/yr, with 60 to 70% occurring between March and July. Therefore, soil moisture is often not sufficient for optimum wheat grow in the fall. No-tillage (NT) systems often increase soil moisture by increasing infiltration and decreasing evaporation. However, higher grain yields associated with increased soil water in NT have not always been observed. Cropping systems with winter wheat following several alternative crops would provide improved weed control through additional herbicide options and reduced disease incidence by interrupting disease cycles, as well as allow producers several options under the 1995 Farm Bill. However, fertilizer nitrogen (N) requirement for many crops often is greater under NT than CT. Increased immobilization and denitrification of inorganic soil N and decreased mineralization of organic soil N have been related to the increased N requirements under NT. Therefore, evaluation of N rates on hard red winter wheat in continuous wheat and in cropping systems involving "alternative" crops for the area have been evaluated at the South Central Field. The continuous winter wheat study was established in 1979. The first of the alternative cropping systems where wheat follows short- season corn was established in 1986. The second (established in 1990) has winter wheat following soybeans. Both cropping systems use NT seeding into the previous crop's residue. All three systems have the same N rate treatments.

Procedures

The research was conducted at the KSU South Central Experiment Field, Hutchinson. Soil was an Ost loam. The sites had been in wheat previous to the start of the cropping systems. The research was replicated five times using a randomized block design with a split plot arrangement. The main plots were crops, and the subplots were six N levels (0, 25, 50, 75, 100, and 125 lbs/a). Nitrogen treatments were broadcast applied as NH_4NO_3 prior to planting. Phosphate was applied in the row at planting. All crops were produced each year of the study. Crops are planted at the normal time for the area. Plots are harvested at maturity to determine grain yield, moisture, and test weight.

Continuous Wheat

These plots were established in 1987. The conventional tillage treatments are plowed immediately after harvest and then disked as necessary to control weed growth. The fertilizer rates are applied with a Barber metered screw spreader prior to the last tillage on the CT and seeding of the NT plots. The plots are cross-seeded to winter wheat. As a result of an infestation of cheat in the 1993 crop, the plots were planted to oats in the spring of 1994. The fertility rates were maintained, and the oats were harvested in July. Winter wheat has been planted in the plots since the fall of 1994.

Wheat after Corn

In this cropping system, winter wheat is planted after a short-season corn has been harvested in late August to early September . This early harvest of short-season corn allows the soil profile water to be recharged (by normal late summer and early fall rains) prior to planting of winter wheat in mid October. Fertilizer rates are applied with the Barber metered screw spreader in the same manner as for the continuous wheat.

Wheat after Soybeans

Winter wheat planted after a maturity group I soybean has been harvested in early to mid September in this cropping system. As with the corn, this early harvest again allows the soil profile water to be recharged prior to planting of winter wheat in mid October. Fertilizer rates are applied with the Barber metered screw spreader in the same manner as for the continuous wheat.

Winter wheat also is planted after canola and sunflowers to evaluate the effects of these two crops on yield. Uniform N fertility is used; therefore, the data were not presented.

Results

Continuous Wheat

Grain yield data for continuous winter wheat from the plots are summarized by tillage and N rate in Table 6. Wheat yields in the CT and NT treatments were comparable for the first 4 years. In the fifth year (1992), cheat started to become a serious yield-limiting factor in the NT treatments. By 1993, it had almost completely taken over the NT treatments. As a result of the cheat problem, the plots were planted to oats in the spring of 1994. This allowed for a significant reduction in cheat. The results for 1995 were not affected by cheat but more by the climatic conditions of the year. The cool wet winter with lush growth was followed by a warm period. This then was followed by cold wet weather during seed setting and grain filling. The yield data reflect these conditions. The yield increases that occurred with increasing N rate did not materialize that year. These weather conditions contributed to the no-till treatments having greater yield reductions than the conventional treatments. Conditions in 1996 and 1997 proved to be excellent for winter wheat production in spite of the dry fall of 1995 and the late spring freezes in both years.

Wheat after Corn

Wheat yield increases with increasing N rates were observed in wheat following corn in 1988 and 1990 (Table 7). The extremely dry conditions from planting through early May of

1989 caused the complete loss of the wheat crop in the rotation for that year. In 1988, 1990, 1991, 1992, and 1993, when timely precipitation occurred in both germination and spring regrowth periods, wheat yields following corn were comparable to those of wheat following wheat. Though not as apparent with sorghum, the effect of reduction in soil N in the 0 N plots also can be seen in the yields. Wheat yields in 1994 showed the benefits of the cool wet April and early June. If these conditions had not occurred at the right time of the plant's development, yields would have been considerably less. Weather conditions were quite different for the 1995 wheat crop in the rotation. These conditions caused considerable variability and reductions in yields in comparison to 1994. However, the yields in the rotation were higher than those of continuous wheat. Also, the test weights for the wheat in the rotation averaged 60 lb/bu, but the average for the continuous wheat was only 53 lb/bu. This points out the necessity to use some type of rotation in the farming operation to produce high quality crops. In 1996, the corn prior to wheat was dropped, and cover crops were added to this cropping system.

<u>Wheat after Soybeans</u>

Wheat yields after soybeans also reflect the differences in N rate. However, comparing the wheat yields from this cropping system with those where wheat followed corn shows the effects of residual N from soybean production in the previous year. This is especially true for the 0 to 75 lb N rates in 1993 and the 0 to 125 lb rates in 1994 (Table 8). Yields in 1995 reflect the added N from the previous soybean crop, with yield by N-rate increases similar to those of 1994. As the rotation continues to cycle, the differences at each N rate probably will stabilize after four to five cycles, with a potential to reduce fertilizer N applications by 25 to 50 lbs/a where wheat follows soybeans.

Other Observations

Nitrogen application significantly increased grain N contents in all crops. Grain phosphate levels did not seem to be affected by increased N rate.

Loss of the wheat crop after corn can occur in years when fall and winter moisture is limited. This loss has not occurred in continuous winter wheat regardless of tillage or in the wheat after soybeans. Corn will have the potential to produce grain in favorable years (cool and moist) and silage in nonfavorable (hot and dry) years. In extremely dry summers, extremely low grain sorghum yields can occur.

Grasses were the major weeds in the wheat after corn system. This was expected, and work is being done to determine the best herbicides and time of application to control grasses.

Table 6. Wheat yields as affected by tillage and nitrogen rate in a continuous wheat cropping system, South Central Kansas Experiment Field, Hutchinson.

	Yield bu/a																			
	1988		1989[1]		1990		1991		1992		1993[2]		1994[3]		1995		1996		1997	
N Rate[4]	CT[5]	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT
0	39	32	35	12	58	50	53	53	40	26	28	2	34	25	26	16	46	23	47	27
25	44	41	38	28	60	57	72	70	42	40	31	3	55	52	28	12	49	27	56	45
50	40	39	35	27	57	57	74	60	45	38	28	3	59	63	30	9	49	29	53	49
75	48	46	37	27	60	58	66	62	45	51	31	11	72	73	30	16	49	29	50	46
100	46	50	37	31	58	61	65	56	45	42	27	10	66	76	23	15	46	28	51	44
125	41	48	36	30	55	59	67	57	44	44	26	4	64	76	23	12	45	25	48	42
LSD* (0.01)	NS	10	NS	11	NS	NS	9	9	NS	13	NS	5	17	17	NS	6	NS	NS	8	8

* Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be placed in one being greater than the other.

[1] ANOVA for three replications.

[2] Severe cheat infestation in NT treatments.

[3] Yields for oat crop.

[4] Nitrogen rate in lb/a

[5] CT conventional NT no-tillage

Table 7. Effect of nitrogen rate on wheat yields after corn, South Central Kansas Experiment Field, Hutchinson.

N Rate	Yield						
	1988	1990	1991	1992	1993	1994	1995
lb/a				bu/a			
0	9	21	44	34	18	13	17
25	13	31	71	47	24	27	26
50	17	43	76	49	34	40	24
75	19	53	61	47	37	48	36
100	17	54	62	47	47	48	41
125	19	55	62	44	49	42	37
LSD*$_{(0.01)}$	5	4	7	5	9	4	4
CV $_{(\%)}$	27	8	10	8	15	10	18

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.

Table 8. Effects of nitrogen rate on wheat yields after soybeans, South Central Kansas Experiment Field, Hutchinson.

	Yield						
N Rate	1991	1992	1993	1994	1995	1996[1]	1997
lb/a				bu/a			
0	51	31	24	23	19	35	13
25	55	36	34	37	26	36	29
50	55	37	41	47	34	36	40
75	52	37	46	49	37	36	44
100	51	35	45	50	39	36	45
125	54	36	46	52	37	36	47
LSD$_{(0.01)}$	NS	4	6	2	1	1	4
CV $_{(\%)}$	7	6	9	5	7	2	9

* Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be placed in one being greater than the other.
[1] Spring wheat yields.

EFFECTS OF TERMINATION DATE OF AUSTRIAN WINTER PEA WINTER COVER CROP AND NITROGEN RATES ON GRAIN SORGHUM

William F. Heer

Summary

This was the first year for this rotation. The effects of the cover crop most likely were not expressed. Limited growth of the cover crop (winter peas) because of weather conditions produced limited amounts of organic nitrogen (N). Therefore, the effects of the cover crop when compared to fertilizer N were limited and varied. The rotation is being continued, and the wheat crop has been planted for 1998 harvest. After harvest of the wheat, a second cycle of the cover crop will be planted.

Introduction

Renewed interest exists in the use of winter cover crops as a means of soil and water conservation, a substitute for commercial fertilizer, and a way to maintain soil quality. One of the winter cover crops that may be a good candidate is winter pea. Winter peas are established in the fall, overwinter, produce sufficient spring foliage, and are returned to the soil prior to planting of a summer annual. This plant is a legume and has potential for adding nitrogen (N) to the soil system. With this in mind, research projects were established at the South Central Experiment Field to evaluate winter peas, sweet clover, and hairy vetch for their abilities to supply N to the succeeding grain sorghum crop in comparison to commercial fertilizer N.

Procedures

The research was conducted at the KSU South Central Experiment Field, Hutchinson. The soil in the experimental area was an Ost loam. The site had been in wheat prior to starting the cover-crop cropping system. The research used a randomized block design and was replicated four times. Cover crop treatments consisted of fall-planted winter peas with termination dates in April and May and no cover crop (fallow). The winter peas were planted on September 14, 1995 at a rate of 35 lb/a in 10-inch rows with a double disk opener grain drill. Actual dates of termination (DOT) were May 16, 1996 (DOT1) and June 4, 1996 (DOT2). Prior to termination of the cover crop, aboveground biomass samples were taken from a 1 square meter area. These samples were used to determine forage yield (winter pea and other) and forage N and phosphorus (P) contents for the winter pea portion. Fertilizer treatments consisted of four N levels (0, 30, 60, and 90 lb N/a). Nitrogen treatments were broadcast applied as NH_4NO_3 (34-0-0) prior to planting of grain sorghum on June 17, 1996. Phosphate was applied at a rate of 40 lbs P_2O_5 in the row at planting. Grain sorghum plots were harvested on November 25 (reps 1 and 2) and December 8, 1996 (reps 3 and 4) to determine grain yield, moisture, test weight, and grain N and P contents.

Results

Winter pea cover crop and grain sorghum results are summarized in Tables 9 and 10, respectively.

Soil conditions at planting of the winter peas were excellent with good moisture. However, the mid-September planting date was later than desired because of above-normal rainfall in late August and early September. After planting, temperatures cooled and limited fall growth in the winter peas occurred.

Fall ground cover ranged from 26 to 36 percent with no significant differences across treatments (Table 9). The winter months were cool and dry. This limited growth and delayed the first date of termination (DOT1) from early April to May 16. Date of termination 2 (DOT2) also was delayed by wet conditions in May to June 4. Winter pea aboveground biomass at DOT1 was about one-half that at DOT2 (Table 9). However, no significant differences in dry matter (DM) production occurred within DOTs. Differences in the percent N in the DM existed in the treatments for DOT2. These differences are not related the treatment but to natural occurrence (no treatments were applied to the cover-crop plots prior to termination).

Large amounts of N were not produced by the winter pea cover crop. Nitrogen credited to the cover crop ranged from 9.48 to 30.70 lb N/ac. These N levels did not carry forward to increased grain yield in the grain sorghum crop. Only the no-N treatments with and without the cover crop and the DOT1 no-cover crop and cover crop plus 90 lb/a N treatments had significantly lower grain yields (Table 10). Flag leaf N (%) and whole plant N (%) were decreased in the no-N treatments with or without cover crop. The highest flag leaf and whole plant N occurred in the April cover crop plus 90 lb/a N treatment. Thus, the overall effect of the cover crop and N fertilizer on flag leaf and whole plant N and grain yield was not always significant or consistent.

As with other N-rate studies on the South Central Field, the first increment of fertilizer N had the greatest effect on leaf and whole plant N and grain yield. Sorghum yields in DOT1 were not significantly different by treatment. In DOT2, approximately 30 lb/a N as fertilizer was needed to produce a sorghum yield comparable to that with cover crop with no added N. Highest sorghum yields occurred in the DOT1 no-cover crop plus 30 lb/a N and DOT2 cover crop plus 30 and 60 lb/a N treatments.

Table 9. Effects of termination date and nitrogen fertilizer on winter pea growth in a grain sorghum - winter wheat-cover crop rotation, South Central Kansas Experiment Field, Hutchinson, 1996.

					Winter Pea[3]	
Termination Date	N Rate[1]	Fall Ground Cover[2]	DM N	DM Yield	N	P
	lb/a	%	%	lb/a	%	
May 16	0	33	9.48	302	3.14	0.26
	30	28	12.43	413	3.01	0.22
	60	30	10.26	342	3.00	0.21
	90	36	22.68	717	3.16	0.23
June 4	0	36	19.71	900	2.19	0.27
	30	34	32.40	1200	2.70	0.32
	60	33	23.98	1110	2.16	0.25
	90	26	30.70	1279	2.40	0.30
LSD (P=0.05)		NS		812	0.49	0.04

[1] Nitrogen applied as 34-0-0 after pea termination prior to planting grain sorghum (see Table 10)
[2] Winter pea cover estimated by 6-inch intersects on one 44-foot line transect per plot.
[3] Winter pea oven dry weight, %N, and %P determined from samples taken just prior to termination.

Table 10. Effects of winter pea cover crop and termination date and nitrogen fertilizer on grain sorghum in a rotation with winter wheat and cover crop, South Central Kansas Experiment Field, Hutchinson, 1996.

Termination Date	N Rate[1]	Flag Leaf N	Flag Leaf P	Whole Plant N	Whole Plant P	Grain N	Grain P	Yield
	lb/a				%			bu/a
April[2] N/pea	0	2.5	0.38	1.1	0.14	1.6	0.26	86.5
	30	2.7	0.44	1.0	0.13	1.6	0.27	93.9
	60	2.8	0.43	1.1	0.11	1.7	0.27	82.6
	90	2.8	0.44	1.2	0.11	1.7	0.25	90.4
April[2] /pea	0	2.4	0.40	0.9	0.11	1.5	0.29	80.2
	30	2.7	0.39	0.9	0.10	1.6	0.26	85.7
	60	2.7	0.38	1.1	0.10	1.7	0.27	90.0
	90	2.9	0.41	1.2	0.14	1.8	0.23	83.8
May[3] N/pea	0	2.1	0.39	0.9	0.13	1.4	0.30	81.4
	30	2.4	0.39	0.9	0.13	1.5	0.28	88.1
	60	2.6	0.40	1.1	0.12	1.6	0.27	90.7
	90	2.6	0.40	1.1	0.11	1.6	0.26	89.6
May[3]/pea	0	2.3	0.40	0.9	0.11	1.4	0.29	85.0
	30	2.5	0.40	1.1	0.12	1.5	0.31	92.4
	60	2.6	0.38	1.2	0.11	1.6	0.26	92.9
	90	2.7	0.41	1.1	0.13	1.6	0.25	90.5
LSD (P=0.05)		0.2	0.02	0.2	NS	0.1	NS	8.9

[1] Nitrogen applied as 34-0-0 after pea termination prior to planting grain sorghum on 17 June.
[2] Early April termination. Actual termination 16 May because of limited growth.
[3] Early May termination. Actual termination 4 June because of delay in April termination.

EFFECT OF SEED TREATMENTS ON WHEAT STANDS AND YIELDS, 1997

Robert L. Bowden and William F. Heer

Introduction

Several new seed treatments are being tested for their effects on winter wheat in the Great Plains region. This study was designed to evaluate effects of 12 seed treatments on emergence (fall stand), fall and spring growth, and grain yield of winter wheat.

Procedures

A seed lot of hard red winter wheat variety Newton from the 1990 harvest was chosen to test the effect of seed treatments on old seed of low vigor. Newton is susceptible to most wheat foliar diseases. Germination in a standard lab test just prior to planting was approximately 40%. Seed was treated in a slurry treater using a total volume of 16 fl oz per 100 lb (cwt). Seed was planted 1 in. deep at 100 lb/a in Clark-Ost clay loam at the South Central Experiment Field in Hutchinson, KS on 2 October 1996. The experimental design was a randomized complete block with five blocks and 12 treatments. Three treatments contained unknown proprietary ingredients and so are not reported here. Plots were 5 x 20 ft. and then trimmed to 12 ft long for harvest. There were 5-ft alleys between blocks and no borders between plots. Soil moisture was good at planting. Plots received 0.52 in. of rain on 8 October just as seedlings began to emerge. Stand counts were taken from two 3.3-ft sections of inner rows in each plot on 25 October at the zero- to one-tiller stage of development. Percent ground cover was estimated visually on 20 March 1997. Plots were harvested with a small plot combine on 3 July. Seed yields were adjusted to 13% moisture and 60 lb/bu.

Results

All seed treatments increased stand counts and resulted in greater percent ground cover compared to the check (no seed treatment). Plots were damaged heavily by a hard freeze on April 12-13 when plants were at approximately Feekes stage 7 (second node detectable). Tip burn was observed on the flag-1 leaf, and many stems were damaged. Afterwards, plots were affected by drought, which greatly reduced development of foliar diseases. Cool temperatures allowed the injured wheat to survive and produce some grain. No significant root diseases, insect pressure, or barley yellow dwarf were noted. Some leaf rust developed late, but no differences were detected between treatments (data not shown). Five treatments resulted in higher yields than the check. The RTU-Vitavax-Thiram or RTU-Vitavax-Thiram plus GAUCHO 480 treatment gave the highest yields.

Table 11. Winter wheat stand, percent cover, and grain yield as affected by seed treatment, South Central Kansas Experiment Field, Hutchinson, 1997.

Treatment and Rate (fl oz/cwt)	Stand	Cover	Yield	Test Wt
	plants/3-ft	%	bu/a	lb/bu
Dividend 3FS (0.5) + Apron XL 3LS (0.05)	42.4*	91.0*	26.9	57.4
RAXIL-Thiram (3.5)	39.8*	87.0*	29.5*	57.8
RAXIL-Thiram (3.5) + Apron FL (0.1)	48.9*	90.0*	28.6*	57.3
RTU-Vitavax-Thiram (6)	43.7*	88.0*	32.3*	57.6
RTU-Vitavax-Thiram (6) + Apron FL (0.1)	47.3*	90.0*	29.8*	57.2
RTU-Vitavax-Thiram (6) + GAUCHO 480 (1.5)	41.3*	92.0*	34.1*	57.1
RTU-Vitavax-Thiram (6) + RTU-PCNB (3)	44.4*	88.0*	25.8	57.1
RTU-Vitavax-Thiram (6) + RTU-PCNB (3) + Apron	46.9*	90.0*	27.2	56.9
Untreated check	24.5	70.0	23.0	57.2
LSD ($P \leq 0.05$)	5.9	5.6	5.0	N.S.

*Data within column followed by asterisk are significantly different from check according to Fisher's protected LSD.

MULTIPLE-SITE EXPERIMENTS

INFLUENCE OF ROW SPACING AND PLANT POPULATION ON CORN PRODUCTION

W. Barney Gordon, Dale L. Fjell, Scott A. Staggenborg, and Victor L. Martin

Summary

Studies were initiated to investigate the effects of row spacing and plant population on corn grain yield. Two sites (one dryland and one irrigated) were located in Republic County and one irrigated test was located at the Sandyland Experiment Field near St. John. The test consisted of three row spacings (30, 20, and 15 inches) and four plant populations (20,000, 26,000, 32,000, and 36,000 plants/a).

Growing season rainfall was 8 inches below normal at the Belleville site. The test averaged only 64 bu/a. Conventional 30-inch rows outyielded the 20- and 15-inch rows by 23 and 27 bu/a, respectively. Plant population did not significantly affect grain yields at the Belleville location. At the Larson Farm, yields in 20- and 15-inch rows were 27 bu/a greater than yields in the conventional 30-inch rows. No differences occurred between 20- and 15-inch rows. Yield continued to increase with increasing plant population up to 32,000 plants/a. At the St. John location, yield at 32,000 plants/a was 14 bu/a greater in the 15-inch rows than in the conventional 30-inch rows. When averaged over all plant populations, yields were 12 bu/a greater in 15-inch rows than in 30-inch rows.

Introduction

Early in the century, corn was grown in rows spaced about 40 inches apart to accommodate horse-drawn equipment and later mechanized equipment and post-emergent cultivation practices. The development of effective chemical herbicides and narrow row equipment has given producers the option of reducing row spacing. With the development of corn headers for combines capable of harvesting 15- to 20-inch rows, interest in narrow-row corn spacing (less than 30 inches) is being renewed among producers in many regions. Recently published information on narrow row spacings is limited. Most narrow-row corn research has been conducted in the upper Mid-West region and has compared only two row spacings (conventional 30 inch to one other narrower spacing). Information concerning effects of narrow row spacing on corn grain yields is needed under Kansas conditions. This research compares conventional 30-inch rows to 15- and 20-inch rows at four plant populations ranging from 20,000 to 36,000 plants/a.

Procedures

Experiments were conducted at the North Central Kansas Experiment Field near Belleville, the Richard Larson Farm at Scandia (both sites in Republic County), and the Sandyland Experiment Field located at St. John. The soil at Belleville is a Crete silt loam, and the soil at the Larson Farm is a Carr sandy loam. The experiment at St. John was conducted on a Pratt loamy fine sand. The Belleville site was dryland. The Larson and St. John locations were both center pivot irrigated. The experiment consisted of three row spacings (30, 20, and 15 inches) and four plant populations (20,000, 26,000, 32,000, and 36,000 plants/a). In addition, the experiments at Belleville and St. John included two corn hybrids (Pioneer 3394 and Pioneer 3325). The corn hybrid Pioneer 3394 was used at the Larson Farm. A John Deere 71 Unit planter was used to plant all locations. Plots consisted of four 30-inch, six 20-inch, or eight 15-inch rows. All plots were overplanted and thinned to the desired populations. Planting dates were 22 April, 23 April, and 5 May at Belleville, Scandia, and St. John locations, respectively. Corn was hand harvested and shelled.

Results

Rainfall at the Belleville location was 8 inches below normal during the 1997 growing season. The drought greatly reduced grain yields. Grain yield, averaged over all treatments, was only 64 bu/a (Table 1). Results at the Belleville location show that 30-inch rows yielded 23 and 27 bu/a more than 20- and 15-inch rows, respectively. Plant populations did not affect yield.

Yield at the Larson Farm averaged 180 bu/a (Table 2). Yields in 15- and 20-inch rows were 27 bu/a greater than those in the conventional 30-inch rows. No yield differences occurred between 20- and 15-inch rows. Yields continued to increase with increasing plant population up to the 32,000 plants/a level at all three row spacings.

Yields at the Sandyland Experiment Field averaged 240 bu/a (Table 3). Yields at 32,000 plants/a were 14 bu/a greater in 15-inch rows than in the conventional 30-inch rows. When averaged over all plant populations, yields were 12 bu/a greater in the 15-inch rows than in 30-inch rows. Both hybrids responded to row spacing and plant populations in a similar manner.

Results in 1997 indicate that corn with high yield potential, either under irrigation or grown in a favorable dryland environment, will respond quite well to narrow rows. In situations were yield potential is limited, 30-inch row spacing may be the best choice. Optimum populations under irrigated conditions were around 32,000 plants/a. Even in drought-affected corn, high populations did not adversely affect yields.

Table 1. Effects of row spacing and plant population on corn grain yield, North Central Kansas Experiment Field, Belleville, 1997.

Row Spacing	Population	Yield
	plants/a	bu/a
30 inches	20,000	79
	26,000	79
	32,000	83
	36,000	82
20 inches	20,000	62
	26,000	57
	32,000	57
	36,000	58
30 inches	20,000	52
	26,000	54
	32,000	55
	36,000	55
<u>Row Space Means</u>		
30 inches		81
20 inches		58
15 inches		54
LSD (0.05)		11
<u>Hybrid Means</u>		
Pioneer 3394		76
Pioneer 3225		52
		6
<u>Population Means</u>		
20,000		64
26,000		63
32,000		65
36,000		65
		NS*

*Not significant at the 0.05 level of probability.

Table 2. Effects of row spacing and plant population on corn grain yield, Larson Farm, Scandia, KS, 1997.

Row Spacing	Population	Yield
	plants/a	bu/a
30 inches	20000	134
	26,000	156
	32,000	177
	36,000	180
20 inches	20,000	163
	26,000	188
	32,000	200
	36,000	204
15 inches	20,000	167
	26,000	182
	32,000	200
	36,000	206
Row Space Means		
30 inches		162
20 inches		189
15 inches		189
LSD(0.05)		8
Population Means		
20,000		154
26,000		175
32,000		192
36,000		197
LSD(0.05)		10

Table 3. Effects of row spacing and plant population on corn grain yield, Sandyland Experiment Field, St. John, KS, 1997.

Row Space	Population	Yield
	plants/a	bu/a
30 inches	20000	217
	26,000	234
	32,000	245
	36,000	246
20 inches	20,000	225
	26,000	243
	32,000	241
	36,000	244
15 inches	20,000	232
	26,000	242
	32,000	259
	36,000	253
<u>Row Space Means</u>		
30 inches		235
20 inches		238
15 inches		247
LSD(0.05)		NS*
<u>Hybrid Means</u>		
Pioneer 3394		241
Pioneer 3225		239
LSD(0.05)		NS
<u>Population Means</u>		
20,000		225
26,000		240
32,000		248
36,000		248
LSD(0.05)		10

*Not significant at the 0.05 level of probability.

CORN YIELD RESPONSE TO VARIABLE-RATE PLANTING

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Summary

Grain yields either increased or remained unaffected as plant populations increased from 20- to over 34,000 plants/a, and yield levels varied across locations within a given field. This relationship was consistent across environments that ranged in yield from 128 to 216 bu/a. These results do not support the use of variable-rate corn seeding to reduce plant populations in the lower-yielding areas of a field in an attempt to increase overall grain yields. Variable-rate technology may be useful as means of achieving adequate stands in areas where stand establishment is difficult to achieve and in order to plant dryland corners and areas under a sprinkler irrigation system with one pass across the field.

Introduction

Corn seeding rates historically have been selected conservatively to avoid crop disasters from drought stress in dry years. Based on such ideology, changing seeding rates within a field in response to soil variations is believed to maximize grain yields. This is accomplished by planting lower plant populations in the droughty sites in a field and increasing the plant populations in the more productive areas. Recent corn population studies conducted in northeast Kansas have indicated that higher plant populations resulted in higher yields under excellent growing conditions and did not reduce yields under severe water stress, thus calling into question the need for variable-rate corn seeding. The objectives of this study were to determine if variable-rate planting would increase corn yields.

Procedures

Field studies were conducted in 1996 and 1997 to assess the interaction between soil yield levels and corn populations. These studies were conducted in a field in Doniphan County, at the Irrigation Experiment Field in Republic County, and in a field in western Shawnee County. The Doniphan County site had highly variable soil type, depth, and elevation as a result of natural erosion. Elevations varied as much as 40 feet within the field. The Republic County site consisted of a gently sloping irrigation bed that was leveled to conform to furrow irrigation. The Shawnee County location was center pivot irrigated and had slight changes in elevation. Variations in pH were observed during the 1996 growing season while it was cropped to soybeans.

In all three fields, plant population treatments were strip applied along the length of the entire field (Figure 1). Grain yields were determined in predesignated locations within each population strip. These field locations were selected based on expected yield variations as a result of field elevation or soil characteristics.

In Doniphan County, two corn hybrids, Pioneer 3489 and Asgrow RX789 were planted in 1996. In 1997, Asgrow RX701 was planted. In both years, four seeding rates were used to establish final stands of approximately 22-, 26-, 30- and 34,000 plants/a. Stands were counted and grain harvested (75 ft.^{2}) within each predetermined field location. These locations were selected to consist of side slopes, hill tops, and eroded

areas within the field. At the Republic County site, Pioneer 3394 was planted in both years at

the same populations as at the Doniphan County site. Yields were determined with a plot combine (250 ft^2) at 10 sites at 100 ft. intervals through each population treatment. At the Shawnee County site, populations of 22-, 28-, and 34,000 plants/a were established. The hybrid Pioneer 34K77 was used. Grain yields were determined (60 ft^2) at five field locations that were selected from a soybean yield map from the previous season.

All field locations were geo-referenced using a Trimble Ag120 GPS unit. Soil samples (0-6 in.) were taken at each field location after the 1996-growing season at the Doniphan and Republic sites.

Results

Plant population treatments did affect grain yields differently at the predetermined locations in the fields at any of the sites during the 2 years of this study, as indicated by nonsignificant location x plant population interactions (Table 4). At four of the site-years, increasing plant populations resulted in increased grain yields (Table 5). At the Doniphan County site in 1997, no yield response to increasing plant populations was observed.

Grain yields responded to growing season moisture. The high yields at the Republic and Shawnee County sites reflected the supplemental moisture from irrigation. During the 1996 growing season, above- average rainfall and ideal growing temperatures occurred. This resulted in excellent dryland grain yields at the Doniphan County site. During 1997, rainfall was below average and temperatures were above average during the month of July throughout the region. These conditions resulted in lower overall yields at the Doniphan County site.

Grain yields did vary at the different locations within the fields at the Doniphan and Republic County sites (Figures 2 & 3). Field locations were selected based on elevation at the Doniphan County site and at regular intervals at the Republic County site. Yield variation among the field locations at the Shawnee County site was lower than at the other sites (data not shown). At this site, locations within the field were selected from a yield map of soybeans grown in 1996. This site contains large variations in soil pH, which affected soybean yields in 1996, but appeared to have little effect on corn yields.

Variable-Rate Recommendations

Results from variable-rate seeding studies conducted during 1996 and 1997 indicated that the higher plant populations resulted in the maximum grain yield even at the lower-yielding locations in the fields. These results suggest that variable-rate seeding will not result in higher yields compared to using the uniform seeding rate necessary to maximize yields at the higher-yielding field locations. However, the yields achieved during these studies were above 128 bu/a, higher than many yield levels achieved under dryland conditions in northeast Kansas. To supplement these data, results from dryland corn plant population studies conducted during 1996 and 1997 were included in the following summary.

Combining the results of several corn population studies showed average grain yields from 80 to over 180 bu/a (Figure 4). Across all environments, increasing plant populations from approximately 20,000 plants/a to over 34,000 plants/a resulted in no change or increased grain yields. Grain yields did not decline in any environment as the plant population increased.

The primary focus of variable-rate seeding is to be able to reduce plant populations in low yielding areas and, thus, increase grain yields overall in a given field. However, the results from these studies indicate that such an approach will not accomplish this goal.

However, this approach has potential uses to address other problems. One situation where variable-rate seeding may be useful to increase grain yields would be planting at higher rates in areas of the field where stand establishment has been a problem and resulted in lower yields. Another potential benefit for this technology would be the ability to plant dryland corners of a center pivot field at lower plant populations than used the under sprinkler.

An argument could be made for reducing seed number in the lower-yielding environments to save on seed costs because more seeds may not result in higher yields. However, this should be approached with caution, because lower seeding rates probably will result in more lost yields in a year with excellent growing conditions than it will save in seed costs during the drier years.

Acknowledgments

This project was supported partially by the Kansas Corn Commission.

Table 4. Analysis of variance results for five location-years.

Source	Doniphan 1996	Scandia 1996	Doniphan 1997	Scandia 1997	Shawnee 1997
			Prob > F		
Location (Loc)			Confounded Strip Treatment		
Population (Pop)	0.45	**0.04**	0.92	**0.01**	**0.01**
Hybrid (Hyb)	0.07	N/A	N/A	N/A	N/A
Loc*Pop	0.51	0.68	0.22	0.10	0.55
Loc*Hyb	0.07	N/A	N/A	N/A	N/A
Pop*Hyb	**0.04**	N/A	N/A	N/A	N/A
Loc*Pop*Hyb	0.48	N/A	N/A	N/A	N/A

Table 5. Corn yields at several plant populations for five site-years in Kansas.

Plant Population	Doniphan 1996	Republic 1996	Doniphan 1997	Republic 1997	Shawnee 1997
(plants/a)			bu/a		
22,000	193.6	187.6	150.6	194.5	192.2
26,000	185.0	187.2	153.5	195.5	
28,000					198.1
30,000	184.6	197.1	152.6	196.9	
34,000	200.8	200.4	153.7	187.4	203.9
LSD $_{(0.05)}$	10.7	9.8	NS	2.6	1.3

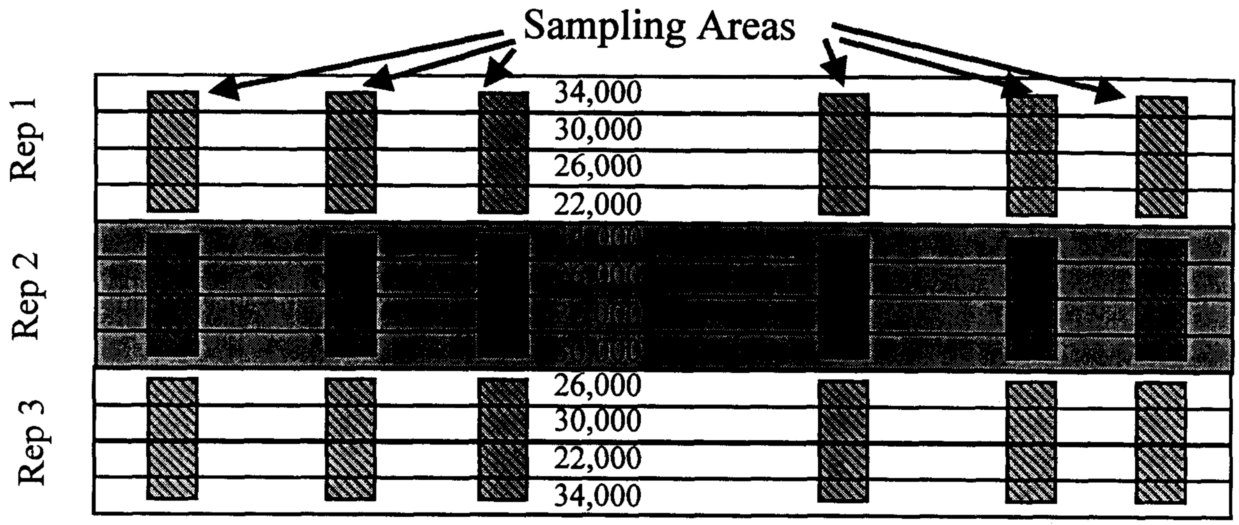

Figure 1. Generic plot layout illustrating plant population treatments and field locations and relative positions.

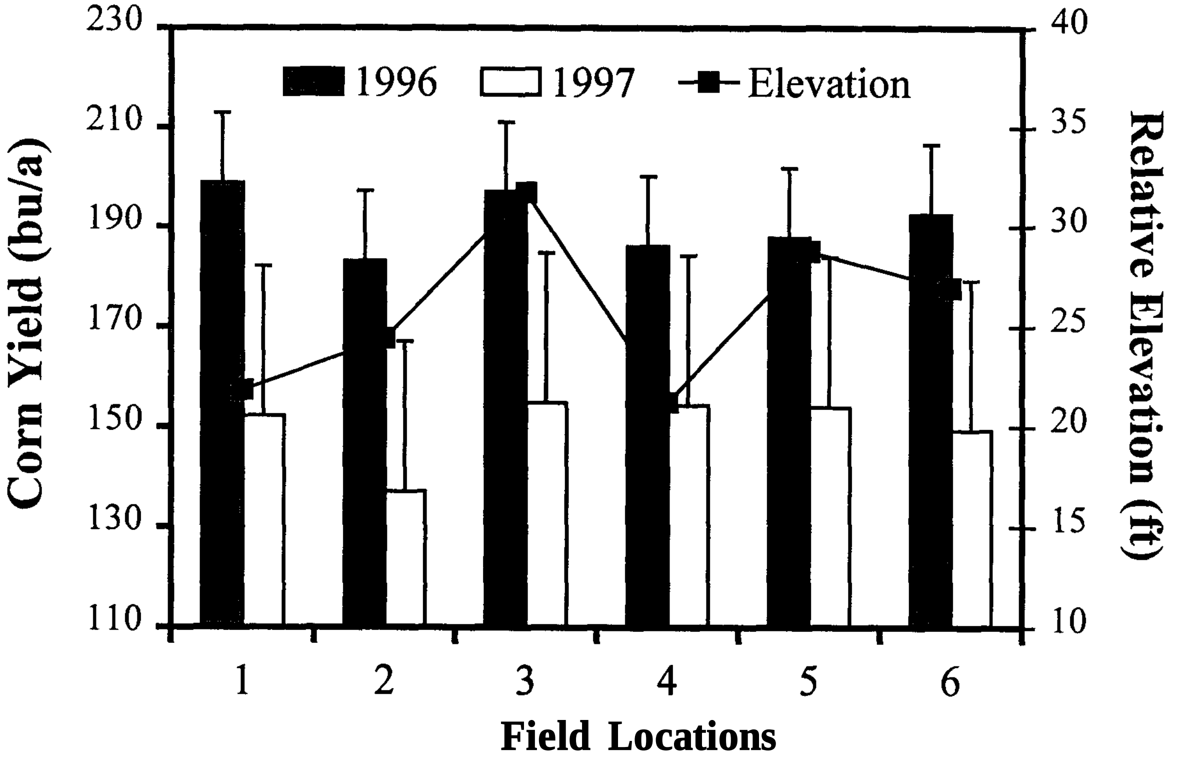

Figure 2. Corn yields and relative field elevation at six field locations for a site in Doniphan County.

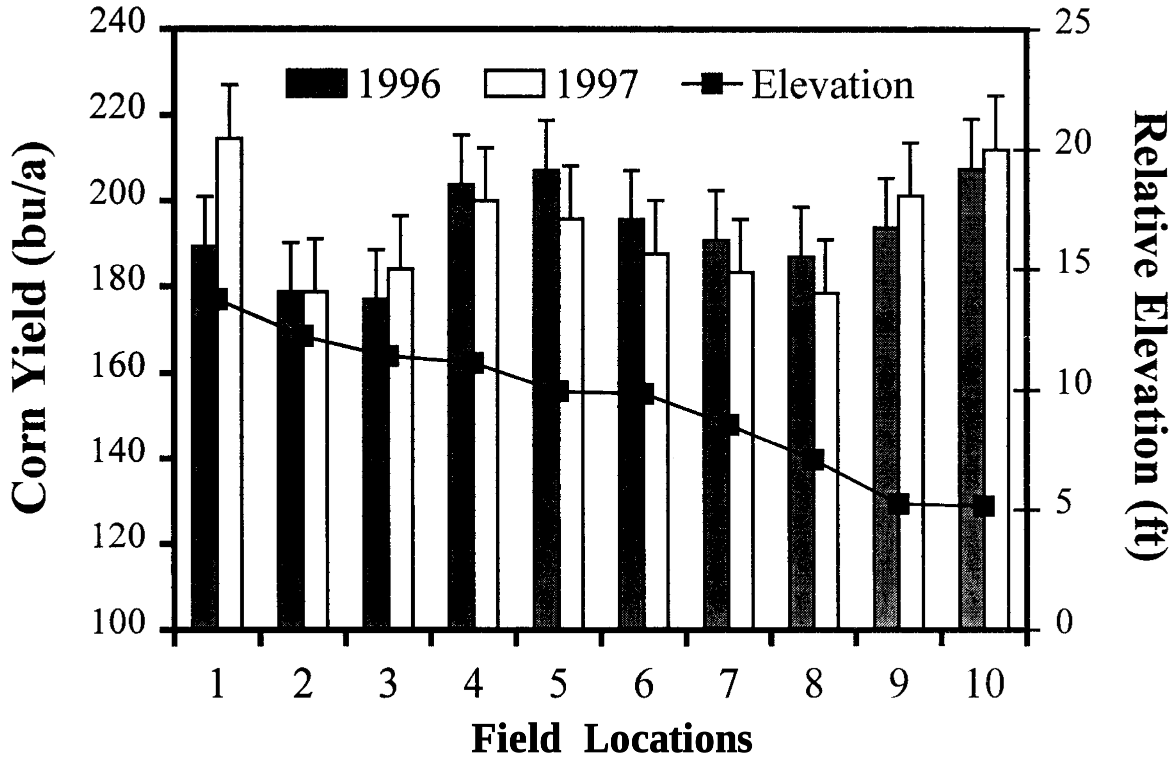

Figure 3. Corn yields and relative elevations at 10 field locations for a site in Republic County, KS.

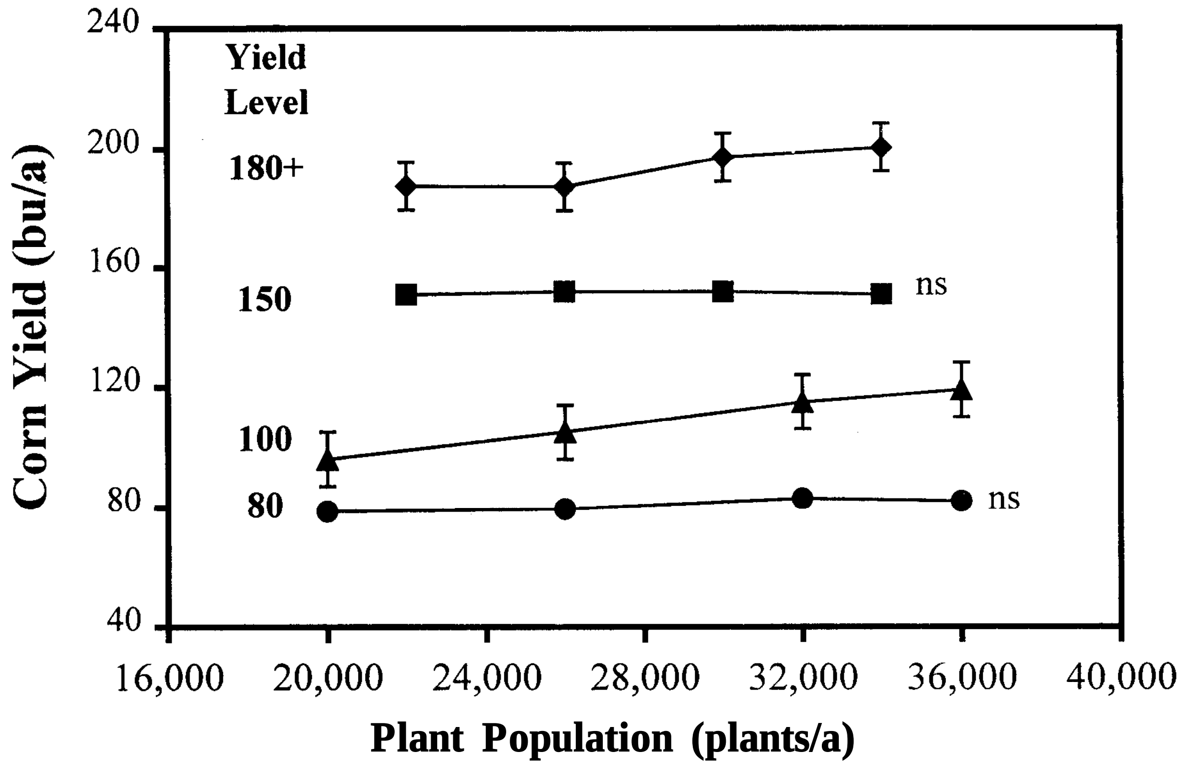

Figure 4. Corn yield response at four levels to increasing plant populations at several locations in Kansas.

EFFECTS OF PLANTING DATE, HYBRID MATURITY, AND HEAD MOTH CONTROL ON SUNFLOWER YIELDS IN THE CENTRAL KANSAS CORRIDOR, 1997

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Summary

Date of planting had opposite effects at opposite ends of the test area in 1997. At the southern sites, planting in April tended to produce the highest yields regardless of head moth control measures taken. June plantings at Hutchinson and Hesston showed no yield benefits from head moth control, supporting common knowledge that by planting sunflowers in June, producers can raise an acceptable crop without treating for head moth. The Scandia plots showed increased yields as sunflower planting was delayed from April to June. In the northern area, the investment in head moth control (about $15/spraying) paid back the producer for plantings from April through June. However, harvest of sunflowers planted in June took place in the middle of what is traditionally the time for wheat seeding and soybean and milo harvests throughout the area. Early planted sunflowers were harvested prior to final wheat seedbed preparation or seeding.

Yields from Hutchinson plantings in April and June favored a fuller season hybrid at the southern end of the area; however, that trend was not evident at Hesston. The fuller season hybrid carried a distinct yield advantage in April and May plantings in the northern location at Scandia. The advantage did not carry into the highest yielding plantings (June), presumably as the result of the shortened growing season. This study will continue at least one more year.

Introduction

Kansas is the third highest sunflower-producing state in the nation. The development of a crushing market in northwest Kansas has led to a 10-fold increase in harvested sunflower acreage in the central corridor of Kansas, from 7,000 acres in 1990 to 71,500 acres in 1996. The central corridor produces roughly ⅓ of the state's sunflowers. The 1995 Farm Bill also has played a major role in the increase in sunflower acreage in central Kansas. Production questions have grown along with producer numbers. Past experience has led many central Kansas growers to plant sunflowers in mid-June to mid-July, either to avoid complications brought on by larvae of the sunflower head moth or as a double-crop option after wheat harvest.

This experiment evaluated the yield responses of two different maturity hybrids over four planting dates (modified from five planting dates in 1996) at intervals of approximately 28 days. The effects of head moth control on yields also were evaluated.

Procedures

Locations included the South Central Experiment Field near Hutchinson (Clark silt loam complex), the North Central Kansas Experiment Field near Scandia (Crete silt loam), the Steve Clanton farm near Minneapolis in Ottawa County (Crete silt loam), and a new site at the Harvey County Experiment Field near Hesston (Ladysmith silty clay loam). All sites were dryland. Sunflowers were planted on four different dates, from mid-April to mid-July at approximately 28-day intervals (Table 6). Treflan® at 2 pints/a was preplant incorporated at the Hutchinson and Hesston sites. Prowl® at 2 pints/a was applied pre-emergence at Minneapolis and preplant incorporated at Scandia. Four row plots of Mycogen Comet (medium early maturity, 90d) and Mycogen Cavalry (medium maturity, 99d) hybrid sunflowers were planted at 24,000 seeds/a at all sites and thinned to a final stand of 21,000 plants/a, if necessary. Plants were monitored for sunflower head moth beginning at ray floret appearance. At 10 and 100% bloom, head moth control plots were sprayed with Warrior® or Asana® at 0.03 or 0.05 lbs. ai/a, respectively, in 20 gallons of water. Larvae counts were taken at 3 weeks after 100% bloom. The center two rows of each four-row plot were harvested for yield as they reached "combine" maturity. Harvest dates are summarized in Table 6. Yields were adjusted to 10% moisture.

Results

Seed yields at Hutchinson were improved by head moth control only for the earliest planting (Table 7), even though moth numbers warranted spraying for the April, May, and June planting dates (Table 7). Head clipper weevils infestations were especially heavy (up to 70% head drop) in the May-planted plots at Hutchinson and resulted in May yields being as low as those of July plantings. May yields were meaningless because of this damage and will be discussed no further. April-planted sunflowers that were treated for head moth had the highest yields in the plot. June-planted sunflowers, regardless of the spray program, produced seed yields equal tothose of unsprayed April plots. July plantings produced the lowest yields. Head moths were controlled in the May-planted plots.

Head moth control did not affect seed yields at Hesston (Table 7). Though no infestation of head clipper weevils was noted at Hesston, May plots yielded similarly to those at Hutchinson. The July plantings at Hesston were low yielding, as would be expected. Because of variability in the plots, no yield differences existed between the April and June plantings, though the April plots tended to yield the best at this site.

Overall, Scandia was the highest yielding environment at over 1850 lbs/a. Head moth control at Scandia paid for itself for every planting date except the July plantings (Table 7), which did not bloom until after moth flights were over. Unsprayed April and May sunflowers yielded no better than July plantings. Unlike results from the two southern locations, but similar to 1996 results from Scandia, yields increased as planting date was delayed from April through May and into June. Yields did decrease with a July planting date as would be expected along the northern border of Kansas.

Stand establishment was very poor in the April and May plantings at Minneapolis. Adequate stands were achieved in June, but the July plots never were planted. Weed control was very poor at Minneapolis, and grasses took over the plots. As was experienced in 1996 at Hutchinson, weed control can be very difficult but is vital in no-till sunflowers. No yields were recorded from the Minneapolis site.

Within a specific planting date, Cavalry, the fuller season hybrid, tended to have higher yields at Hutchinson and Scandia (Table 8), similar to 1996 results from Scandia. This would be expected for the earlier planting dates, and the differences would be expected to be minimized and possibly reversed with later plantings. No significant difference existed between hybrid yields in the June planting at Scandia. At Hesston, however, the yield variability resulted in no advantage to a hybrid within a planting date, except that the shorter maturity hybrid Comet yielded better in the July planting.

Table 6. Planting and harvest dates for sunflowers in a date-of-planting study at Hutchinson, Hesston, and Scandia, KS, 1997.

Hutchinson		Hesston		Scandia	
Planted	Harvested	Planted	Harvested	Planted	Harvested
April 17	August 15	April 22	August 26	April 25	September 12
May 21	August 25	May 15	September 6	May 20	September 12
June 17	October 1	June 20	October 3	June 15	September 30
July 23	November 10	July 19	November 10	July 15	October 15

Table 7. Effects of planting date and head moth control on sunflower yields in a central Kansas study, 1997.

		Hutchinson		Hesston		Scandia	
Planted	Sprayed	Yield	Larvae	Yield	Larvae	Yield	Larvae
		lb/a	no./head	lb/a	no./head	lb/a	no./head
April	Yes	2077†	2.5	1960	1.5	1789	2.5
	No	1596	29	1810	15	1248	33.5
May	Yes	617	1.5	1189	4	2541	3.5
	No	733	46.5	865	36	1497	27.5
June	Yes	1438	2	1559	3	3062	2.5
	No	1327	20.5	1569	8	2241	3
July	Yes	789	2	813	1	1218	0
	No	838	2	802	0.5	1228	1
$LSD_{(0.05)}$		315		516		290	

† Seed yields (adjusted to 10% moisture) at a location must differ by more than the LSD to be considered significantly different.

Table 8. Effects of planting date and hybrid maturity† on sunflower yields in a central Kansas study, 1997.

	Hutchinson		Hesston		Scandia	
Planted	Comet	Cavalry	Comet	Cavalry	Comet	Cavalry
			lb/a			
April	1662‡	2011	1794	1976	1131	1908
May	610	740	976	1079	1702	2337
June	1173	1593	1490	1638	2538	2765
July	808	819	1072	544	1167	1279
$LSD_{(0.05)}$	315		516		290	

† Comet and Cavalry are 90 and 99 days to maturity hybrids, respectively.

‡ Seed yields (adjusted to 10% moisture) at a location must differ by more than the LSD to be considered significantly different.

EFFECTS OF PLANTING DATE, HYBRID MATURITY, AND ROW SPACING ON GRAIN SORGHUM YIELDS IN EXTREME SOUTH CENTRAL KANSAS, 1997

Stewart R. Duncan, Scott A. Staggenborg, G. Ed LeValley, and Glenn E. Newdigger

Summary

The hybrids in this year of the study responded differently to date of planting. Traditional planting dates benefited the early maturing hybrid but had no effect on the fuller season hybrid. Row width did not influence yield in this study, though grain yields from 30-in. row plots tended to be greater than yields from narrow rows. This study will continue.

Introduction

The 1995 Farm Bill has played a major role in the stabilization and increase of grain sorghum acres in central Kansas. Grain sorghum in the south central area of Kansas is planted traditionally in early June or as a double crop after wheat harvest. Research results from the 1990's at the Harvey County Experiment Field near Hesston, the Sandyland Experiment Field near St. John, and the North Central Kansas Experiment Field near Belleville have shown a consistent yield increase attributed to planting sorghum 3 to 4 weeks earlier than traditional planting dates for the area. In years when crop yields from traditional planting dates were greater than those from earlier planted sites, the earlier planted crop yields were still very acceptable. In addition, harvest dates are generally 3 to 4 weeks earlier with earlier plantings.

This experiment evaluated the yield response of two different maturity hybrids planted in two different row spacings at two planting dates, early May and early June, at intervals of approximately 28 days.

Procedures

Locations were the Dean Coursen farm near Kiowa, in Barber County (Grant silt loam) and the Wellington Area Test Farm near Wellington, in Sumner County (Tabler silty clay loam). Grain sorghum was seeded on May 5 and June 9 at both locations in 10-in. and 30 in. rows. Early (Pioneer 87G57) and medium early (Pioneer 8505) hybrids were planted at rates to achieve final stands of 32,000 plants/a. Appropriate grass and weed control herbicides and 85 lbs. N/a were broadcast applied preemergence. At harvest maturity, the center two rows (30-in. rows) or the center 5 feet (10-in. rows) of each plot were combine harvested. Harvest dates at Wellington were September 11 for the May 5 planting and November 21 for the June 9 planting. The Kiowa plots were not harvested. Yields were adjusted to 12.5% moisture.

Results

On June 11, a severe rain and hailstorm shredded the Kiowa plots, terminating that experimental site for 1997. Results from previous studies in north central and northeastern Kansas have shown a trend towards higher grain yields in narrower rows when growing season precipitation is average to above normal. Grain yields at Wellington were not affected by row spacing (Table 9), even though moisture was adequate to surplus throughout the growing season. Grain test weight, however, was a full point higher in the narrow rows (Table 9). In May-planted plots (harvested 9/11), grain moisture was 1.5% lower in 10 in. rows (16.3%) vs. 30-in. rows (17.8%). However, with a late November harvest (11/21) after several freezes, row spacing had no influence on grain moisture in the June-planted plots.

Experiment field research consistently has shown a yield advantage to the fuller maturity hybrids at the earlier planting dates. As planting date is pushed back into June, this advantage will disappear gradually and often reverse, with the yield advantage going to the earlier maturing hybrid. Though 22 bushels better than the 10-year Sumner County average, yields from the May planting of Pioneer 87G57 at 70 bu/a (Table 10) were the lowest at the site. But, when planted in June, the early maturing hybrid had yields similar to Pioneer 8505 yields from either planting date. Pioneer 8505 yields were stable across planting dates. Results from studies at Hesston have shown no yield advantage to early planting when July and August precipitation comes in timely, adequate amounts, and the growing season precipitation at Wellington followed that pattern. Earlier maturity hybrids usually have lower test weights, and in this study, the early hybrid weighed nearly 3 lbs/bu less than the medium early hybrid (Table 10).

Table 9. Row spacing effect on grain sorghum near Wellington, KS, 1997.

Row Spacing	Grain Yield	Test Weight
inches	bu/a	lb/bu
10	78	56.0
30	83	54.9
$LSD_{(0.05)}$	NS	1.05

Table 10. Planting date and hybrid maturity effects on grain sorghum yield and test weight near Wellington, KS, 1997.

Hybrid	Planting Date	Grain Yield	Test Weight
		bu/a	lb/bu
Pioneer 87G57	May 5	70	54.6
	June 9	83	53.5
Pioneer 8505	May 5	87	56.4
	June 9	82	57.2
$LSD_{(0.05)}$		11	1.6

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